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A Migration Analysis of Demographic Transitions in the Upper-Midwest from 2006-2010

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By

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ABSTRACT

Rural communities in the Upper-Midwest are essential for contributions to agriculture, oil and development of economic networks to larger towns and cities. Concerning rural population stability and transitions, this research study aims to discover complex migration flows by constructing specified groups of Upper-Midwest regions (i.e., Bakken oil, Taconite iron, high agriculture, developing area of rural depopulation and Interstate 94). Research questions on migrant distributions will be answered by investigating (in-) and (out-) flow data by demographic characteristics (e.g., age, gender and ethnicity) on a county-to-county level. By weighing total demographic populations, a more accurate representation of migration trends called Crude Net-Migration Rates (CNMR) are utilized as the primary variables with desired spatial statistical methods (Global and Local Moran's I index). Global and Local Moran's I Index detects the strength of spatial patterns (i.e., cluster, dispersed or random) and reveals areas of statistical significance related to human mobility all within a Geographic Information System (GIS) context. Results show a connection of pertinent demographic attributes with certain regional migrations: (a) young adults and males generally move to the Taconite iron region or agricultural areas to attain jobs in demand, and (b) higher percentages of females, college-aged and Asian migrants, frequently move to counties with a sizeable university or larger metropolitan. This examination of regional migration flows in a geographical perception identifies types of current migration events and leads to speculation of causes and effects. This research can be further applied to investigate additional findings by limiting the scope to a smaller area with defined spatial units and correlation of new or past time-series data to indicate potential migration flows.

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CHAPTER 1: INTRODUCTION

1.1 Problem Statement

Sustaining a diverse, stable population in rural communities is vital to the Upper Midwest for strengthening economic networks within a region. Small towns and established rural living areas provide economic links to larger cities, therefore human movement and goods can easily travel place to place (Zelinsky, 1962). However, with the use of mechanization of farm equipment, there has been an increase in farm size and an overall decrease in total farm numbers (Loftsgard and Voelker, 1963). With these developments continuing to present day, this has led to drops in rural employment and the migration of rural farmers to urban areas. In this case rural migration and the disparity of demographic migrations are at the forefront of the analysis. Understanding human mobility in a particular time period in conjunction with specific to regional developments, can lead to theoretical reasoning of why certain types of migration patterns are occurring.

This paper aims at identifying different migration series in the Upper Midwest examining patterns, causes, and consequences. An initial problem in this case is the contradiction of migration flows between data sources. For example, migration flows for economic characteristics are available from 2007-2011 at the U.S. Census Bureau, however migration flows for demographic characteristics are available in an American Community Survey dataset from 2006-2010. Demographic characteristics are targeted in order to understand regional age, gender and ethnic migration patterns, even though economic, housing and job related characteristics are other valid inquiries to observe. When recognizing the composition of people in a region and why people are moving into or away from an area, demographic attributes are most critical. Distinguishable inflows and outflows of specific population groups to a region impact policy, planning, education systems, and economic services among local systems. Matching demographic migration flow data to a large number of spatial units is a challenging but obtainable project. Regional migration patterns and demographic movements can be analyzed at a county-to-county level using spatial analysis tools in Geographical Information Systems (GIS). To amplify flows at points of interest in a region, flows can also be narrowed down to smaller administrative units such as Census Tracts, Minor Civil Divisions (MCDs), or Traffic Analysis Zones (TAZs), for further investigation. Census Tracts are outlined subdivisions formed by the U.S. Census Bureau when conducting statistical surveys across an area. Similarly, MCDs are an administrative boundary used by the U.S. Census Bureau, which are comparable to a township. Lastly, TAZs are constructed from census block units primarily utilized by transportation planners and modeling. This report on demographic migrants contributes topical migration events, documentation on ethnic mobility to specific areas, and a clear-cut understanding of generational movements across Upper-Midwest regions.

Though the United States (U.S.) in its entirety is an intriguing study area for a demographic migration analysis, a vast majority of migration research has already been dedicated to the country's full extent (Baker, 1931; Zelinsky, 1962; Plane, 1984;

Greenwood, 1985; Tobler, 1987; Plane and Mulligan, 1997; Rogers et al., 2003). A smaller region, the Upper-Midwest was formed to achieve a more purposeful and detailed analysis. Zelinksky's (1962) article on migration deduced the main study area, region by region (i.e., New England, Middle Atlantic, East North Central, West North Central, East South Central, West South Central, Mountains, and Pacific), state by state, and county by county. Zelinsky (1962) was successful in delineating different migration structures occurring in rural farm regions in contrast to rural non-farm regions. Regions can be classified by breaking down segmented boundaries or zones based on geographical components. To support the classification of Upper Midwest regions, this analysis specifies land areas based on elements of human and economic geography to compose regions.

Regional analysis is a compelling approach when detecting and solving geographic research problems, since regional sciences can assort to a wide variety of fields and topics (e.g., soil types, crime intensity, wealth distribution, land use, etc.). This all-inclusive Upper-Midwest analysis was effective, with the capability of inspecting multiple migration events with current population totals as a migration rate variable. A parallel research analysis to this thesis accomplished a regional migration outline of the Appalachian region (Ludke and Obermiller, 2014). Their analysis featured data consisting of household, earnings, and education characteristics, with results displaying areas statistically significant by economic migrant types. Some scholars demonstrated conclusive migration research by defining regional areas and acquiring flow data having both points of residences determined (Zelinsky, 1962; Ludke and Obermiller, 2014).

Another main focal point was inspecting the movement of migrating age groups such as children, college-age, and young adults, who are a source of population loss in rural regions. Hispanic/Latino, male migrants, were also notably surveyed to see if any regions have noticed an increased migration, since Hispanic migrations to rural areas have occurred before this analysis due to laborious but well-paying job opportunities (Jones et al., 2007). Ethnic and age related population groups, pertaining to mobility and regional migration were a primary apparatus for this project because diverse settings encourage rural employment, positive socio-economic growth, and sustainability.

Regional analysis is an effective method when inspecting migration events with human population since numerous, prevalent issues can be compared or contrasted to other nearby regions. For example, this analysis will view rural Upper-Midwest regions with three of the devised regions (Taconite iron, Bakken oil, and High crop) constituting strengths to the rural economy in the Upper-Midwest. The opportunity to explore any excessive demographic movements that have recently occurred in these regions is accessible by dissecting those areas of regional interest. The basis of regional analysis coupled with economic or social issues has been researched extensively but a complete account of the Upper-Midwest has yet to be fully examined. At its conclusion, an all-inclusive report of migrations in the Upper-Midwest will be discovered, by generating demographic flows and their association to different types of regional migrations.

1.2 Research Questions

This proposed research focuses on the relationship between migration and socio-demographic factors in the Upper Midwest. It will address the following research questions with intention to bring substantial valid hypotheses in its results.

a. Do the Upper Midwest's migration patterns differ by demographic factors (e.g. age, gender, and ethnicity) at a county-to-county level?

b. Can the separation of rural and urban flows distinguish different types of regional migration and ethnic environments (e.g. Latinos, Asian, African American and Caucasian)?

c. Is it possible to detect the presence of spatial patterns (e.g., clustered, dispersed, and random) of migration by demographic factors and to identify the existence of local spatial clusters of migration?

1.3 Study Significance

Human migration studies fall under many disciplines besides geography (e.g. anthropology, epidemiology, economics, politics, and environmental), expressing the importance and need for continuous migration analyses in a geographical mindset. This study is significant to the geographic field in several ways. First, the study is needed to highlight a recent account of Upper-Midwest's rural migration, since the majority of scholarly work inspects spatial dynamics of urban growth and sprawl. Raising awareness and targeting areas with depopulation issues will lead to stronger protection of natural resources, rural landscapes, and economic markets. Second, this study takes an important step toward finding new commonalities between regional migrations and human characteristics composed of ethnicity, age, and gender traits. Further insight of demographic migrations is required by use of spatial-temporal methods through GIS. Finally, this study is significant for an understanding of current regional migration events and illuminating underlying issues that could surface from this analysis.

CHAPTER 2: LITERATURE REVIEW

2.1 Migration Analyses of Early Population Shifts Prior to 1980

Some of the very first articles concerning human movement were empirical records, chronicling the circumstances and outcomes of European migrations and early United States settlement (Hibbard, 1912; White, 1923; Middleton, 1924). Other early migration studies soon theorized a spatial-temporal approach with human birth/death rates and net-migration figures (Baker, 1931; Leonard, 1944; Zelinsky, 1962; Loftsgard and Voelker, 1963; Chang, 1974; Rainey, 1976). In modern times, the advancement of interpreting and visualizing migration patterns has evolved to spatial analysis methods, one example is a statistical procedure known as Spatial Autocorrelation (Hudson, 1976; Plane and Mulligan, 1997; Yano et al., 2000; Chi and Zhu, 2008; Scardaccione et al., 2010; Jang et al., 2014; Ludke and Obermiller, 2014). This section will provide a basic understanding of existing factors of migration as well as a timeline of migration events and migration research.

The accounts of human migration in the U.S. through academic research has been reported in a variety of different research topics, being discussed in journals pertaining to sociology (Leonard, 1944; Ritchey, 1976), economics (Sjaastad, 1962; Ewing, 1974), environmental science (Darley, 1978; Parton et al., 2007), regional science (Greenwood, 1985; Ludke and Obermiller, 2014), and population geography (Chi and Zhu, 2008; Rogers, 2008). However, many scholars of migration research in the United

States focus on the urbanization aspect instead of the effect it has on rural communities (Davis, 1966; Rogers and Castro, 1984; Eaton and Eckstein, 1997; Yano et al., 2000; Stroper and Scott, 2009). Migration in the United States can be reflected back to the days of pioneer settlement in the 1800's (Hibbard, 1912; Zelinsky, 1962). Westward migration allowed settlers to increase resources and land size for economic opportunities and better quality of living (Hibbard, 1912; Zelinsky, 1962; Hudson, 1976).

Articles focused on rural depopulation events first began in the early 1910's, when rural communities peaked in population. This was the first point of rural decline in the United States since the nation's Independence in 1776 (Zelinsky, 1962). Europe, however, experienced and documented these types of depopulation events prior to the United States (Hibbard, 1912; White, 1923). The internal migration in the 1800's for the United Kingdom, France and Germany was consequential of Europe's agricultural economy disruption, due to prosperous industrial and manufacturing jobs in the cities (Hibbard, 1912; Middleton, 1924). White (1923) called this migration of rural residents to urban locations a "city-drift effect", which is equivalent to the term, "urbanization" in today's terminology.

The shift in the "rural-urban" population environment post-World War II (WWII) triggered an unparalleled impact of socio-economic phenomenon (Baker, 1931; Leonard, 1944; Zelinsky, 1962; Loftsgard and Voelker, 1963; Rainey, 1976; Darley, 1978). The downtown economy following WWII transitioned to a more industrial based landscape, causing people to settle outside the central city. Leonard (1944) discussed population shifts of rural to urban in-migration as a temporary abnormality on behalf of the ending of WWII. Population groups continued to move and settle around major U.S. cities, creating a new social landscape. These spatial transformations along the metropolitan fringes created indistinct boundaries between rural and urban communities (Rainey, 1976). Zelinsky (1962) pointed out the movements to central cities and fringe suburbs were restructured from economic and demographic push factors.

Despite the questionable stability of rural communities, very few reports showed agricultural production and rural-farm populations were declining (Zelinsky, 1962). Leonard (1944) affirmed the bulk of out-migration was happening in what was deemed "rural problem areas," conceived through a correlation analysis of county population data in the Southeast region of the United States. Rural problem areas are communities lowering in total number of church, medical, and school attendance, leading to difficult financial situations and their feeling of community (Leonard, 1944; Rainey, 1976). Eventually, businesses, churches, schools, medical services, and job opportunities popped up in expanding urban settlement areas (Leonard, 1944; Loftsgard and Voelker, 1963; Rainey, 1976). The city-drift effect (urbanization) in the United States occurred with increasing populations at an accelerating rate never seen before (White, 1923; Zelinsky, 1962). Even with the necessity for urbanization studies, research is still vital to maintain productive village settlements because rural communities provide a strong network to cities for a system of good distribution (Ullman, 1941). Even though earlier articles have been remarkably informative, they seem to focus on sociological aftermath of rural depopulation, instead of how rural depopulation can be detected.

2.2 Push Factors of Rural to Urban Migrations

The decision to move from a residence to a new location is not usually decided on a single factor, meaning there is give-and-take from leaving the origin and arriving to a destination. This idea is defined as push-pull factors, regarding migration's pros and cons to specific areas. Petersen (1958) wrote a detailed article on the typology of migration, discussing the general nature of many push-pull factors (e.g., mechanization, transport, prosperity). Push-pull factors are a principal concept when examining why rural migrants move to urban areas in any time period. First, there are numerous determinants influencing the migration of rural inhabitants to urban areas, such as human advancements over time and unavoidable socio-economic circumstances. During the Progressive Era (1890-1920), the first and primary reason why rural-to-urban migration transpired is because of mechanization, refined farm equipment altering the way farmers produced, managed, and sold their crops (Hibbard, 1912; White, 1923; Kollmorgen and Jenks, 1958; Zelinsky, 1962; Loftsgard and Voelker, 1963). Mechanization is using upgraded machinery as the main tools for farming, instead of intensive labor that was needed before. The expansion of agriculture's technology changed the entire rural economic landscape. In the early 1900's, the advancement in more modern equipment allowed farmers to cultivate five times faster than before, increasing the acreage they could farm daily (Zelinsky, 1962). The use of more modern equipment quickened the farming process eliminating the use of farm hands, who worked under farm owners (White, 1923; Zelinsky, 1962). Farm hands, also known as tenant farmers, were now forced to migrate to cities for new opportunities (White, 1923; Zelinsky, 1962). Cities with growing populations and increased industrial plants attracted many young men and women from close proximate rural villages (Baker, 1931). Loftsgard and Voelker (1963) defined farming mechanization as a substitution of labor for capital, in turn increasing farm size and diminishing the amount of farm populations. After World War II, mechanization became more and more high-scale, providing farmers the ability to produce crops at further distances from their farm home (Baker, 1931; Kollmorgen and Jenks, 1958). Moreover, the amount of acreage that crops were cultivated on by a single farmer kept increasing (Loftsgard and Voelker, 1963). Mechanization is still a process occurring today as farming practices become more precise. This advancement has precipitated to modern day precision agriculture, implicating that areas of increased rural out-migrants in agriculturally rich areas, may likely stay a push-factor for continuing years.

Human migration and economic trade was expedited with the development of transportation highways. The expansion of road networks made traveling place to place, increased retail trade, and tourism, more accessible than ever before (Loftsgard and Voelker, 1963; Lichter and Fuguitt, 1980). From the start of 1940 up to 1959, there was a 94% increase of rural farmers with automobiles (Loftsgard and Voelker, 1963). The ownership of motor vehicles by citizens reorganized the landscape of central cities and the rural environment. Kollmorgen and Jenks (1958) state that wealthy farmers have taken advantage of improved and greater number of paved transportation roadways, accumulating more acreage a long distance away from their farm home. As a result of an increased number of rural vehicles and advanced development of roadways, 78% of farmers lived on all-purpose roads in 1959, compared to 32% in 1940 (Loftsgard and Voelker, 1963). A term for farmers who produce crops thirty or more miles away from their farm home are called Suitcase Farmers (Kollmorgen and Jenks, 1958). Kollmorgen and Jenks (1958) revealed Suitcase Farmers in Sully County, South Dakota were farming more acreage than the local townsmen. By virtue of transportation systems and mechanization, farming operations of wheat and corn, and the ability to raise large quantity of livestock, living miles away has never been easier (Kollmorgen and Jenks, 1958). Lichter and Fuguitt (1980) found a correlation between mover's economic status and residence to interstate highway counties by a spatio-temporal analysis from 1950-1970. Although, Lichter and Fugitt (1980) did not add demographic data, contingent on age, gender and ethnicity, they summarized by stating large population groupings in interstate highway counties, impacts levels of positive net-migration over extended periods of time. Rural communities away from major highways have been mostly abandoned, while communities that happened to be a stopping junction for passing by motorists have prospered.

When combating rural settlement issues, there are often few solutions to help relieve rural hardship. Some of these issues include land owning expenses, insufficient planning and small labor force, which all lead to loss of public services (Hibbard, 1912; Rainey, 1976). Hibbard (1912) pointed out that poor rural sentiment was going to be a problem when balancing rural and urban policy arrangements. White (1923) also wondered how rural populations could adjust to negative economic production changes and possibly undergoing a transition to lower standards of living. Rural issues facing populations in the early 20th century have continued into contemporary times (Darley, 1978; Rathge and Highman, 1996; Jones et al., 2007; Parton et al., 2007; Albrecht, 2010; Cantarero and Potter, 2014). State and Federal governments must commit more time and effort to combat on-going issues to boost settlement and development. A couple of these issues include the overlook of problematic local developments (e.g., transportation, environment, and economic trade), the deterioration of small town's population, and feeling of community. Many government officials have the tendency to neglect rural problems, thinking there is greater concerns elsewhere (Darley, 1978). New perspective on rural policies as they evolve will be desperately needed in these cases. Darley (1978) explained new policies that involve reviving struggling rural communities are often set aside. The deterioration of small communities (villages) is present in many Upper-Midwest counties by viewing current census reports. The village's high standard of living and positive well-being is the only hope for their future (Baker, 1931). Darley (1978) also mentioned the disregard of rural well-being is caused by current government policy, which is only accepting rural areas if no negative impacts are affecting transportation systems and/or the environment. This criterion policy focuses on external matters rather than the communities themselves. Bringing consistent favorable attention to rural policy would transcend communities greatly, and stabilize rural-urban networks.

As previously mentioned, regions with decaying rural communities will weaken economic linkages from city to city, detaching any connection and support between rural-urban networks. Rural regions and communities depend on agriculture and natural resources to stay prosperous. White (1923) stressed that without raw materials and agriculture yields from rural areas, a region's per capita income production would be severely lacking. Rainey (1976) expressed how significant rural communities are to urban economic structures, pointing out how rural agriculture maintains the world's food supply. These economic trades from place to place through transportation networks are an everyday operation. Urban markets and services would not flourish without the supply and demand of rural resource accommodations (Rainey, 1976). The importance of examining rural regions is the fact that a large percentage of out-migrating rural dwellers would limit the productivity of a region's land and decrease its only economic strength (Loftsgard and Voelker, 1963). Any abrupt population shifts to a regional environment or neighborhood will have social and economic ramifications (Baker, 1931).

2.3 Demographic Migration Analyses Preceding to Current Migration Patterns

Another element to rural depopulation can be shown in the migration rates of population groups, emphasizing the importance of denoting human characteristics of migrants. Demographically, younger generations are a critical factor, since the majority of them move away from rural communities to urban areas, seeking more and different opportunities such as job and education (Middleton, 1924; Leonard, 1944; Chang, 1974). Middleton (1924) was one of the earliest to announce the drift of young people to cities in search for well-paying industrial and manufacturing jobs. Central cities achieved a favorable geographical attitude for young people such as plenty of entertainment, heightened media coverage, and increased communication with other young people (Loftsgard and Voelker, 1963). Positive socio-economic means in urban areas caused some negative strains in rural areas. Middleton (1924) believed younger people staying in rural areas were emotionally affected by loneliness and had a harder time finding jobs. Current research has shown Middleton's theory continued as modern perceptions on psychological endeavors by college aged and young adults is still a push-factor (Jones et al., 2007; Cantarero and Potter, 2014). He concluded with research observations that the total amount of rural farmers were decreasing, contrary to many believing the populations were just stabilizing in the early 1900s. Rural migration of younger people was not the apparent problem until the years during World War II, and eventually after when suburbanization occurred (Leonard, 1944). In 1940, 23% of the U.S. population were farm families. Fifty years later, farm families in 1990 stood at 1.8% (Mattson, 1997). Baker (1931) observed settlement patterns based on regional population changes, noticing older generations remaining in rural villages in virtue of affordability and embraced lifestyle. He stressed the importance of constantly utilizing a region's strengths to boost local economy and offering job opportunities to the young and working age.

Demographic data is commonly separated and broken down with any provided migration data. Expansive research on demographic flow data has recently advanced spatial modeling methods, thus applied to migrant's age, ethnic, or gender to conclude regional migration outcomes. The age attribute was applied to an analysis researching net-migration and natural population changes on a county level in the state of Iowa (Chang, 1974). Chang's (1974) results showed net out-migration had significantly higher rates in rural counties, which had higher death rates and lower-fertility rates. A different migration analysis used age as a determinant to view any correlations with the distance of migrations (Schwartz, 1974). In Schwartz's (1974) conclusion, age groupings seemed to be unrelated to the elasticity of distance when migrating. However, implementing the spatio-temporal analysis of variables (e.g., age, gender, and ethnicity) across several regions will provide a better understanding of any manifesting migration events. Thompson (1974) affirms migration data requires demographic and/or household characteristics classified in the areal unit for spatial interaction methods. This allows for possible manipulation of data by aggregating or disaggregating flow estimates.

Aggregating age groupings is a common process when classifications types are often every five years leading to an excess number of fields (Rees et al., 2003; Rogers et al., 2003; Raymer et al., 2008). Narrowing the age groups to four to six groups is a more manageable and straightforward assessment than the original excess amount of age groups provided. With aggregate data, placing migrants into living stages (e.g., college, working, retirement) is not going to be an exact measure, but information is often available about the migrants (Rees et al., 2003).

Crude net-migration rate is a more effective way to view total and demographic migrants since absolute estimates may not yield accurate representations of a spatial unit (Holland and Plane, 2001). Migrations can vary widely with age groups. Lopsided age structures can be seen on population pyramid's age distribution for a given region in

Iowa (Chang, 1974). A clear sign of aging and/or increased out-migration on a population pyramid would be seen in the middle and top sections, where the distribution is at its highest, and distorted at the very top and bottom. The importance of observing the younger generation's population in rural areas is crucial, since a region's age structure can be measured for forecasting an area's future population. This approach can also be used for both male and female genders too, forecasting high or low birth events or ethnic patterns to recognize the redistribution of immigrant concentrations (Raymer et al., 2008).

2.4 The Relevance of Regional Migration Focusing on Previous Investigations

McNeil (1978) views migration in a traditional light; the United States is a nation of immigrants and people have a freedom of choice to move about. Past research has shown human migration studies are unique, because no single migration pattern is standard, since temporal migration shifts and determinants change. Numerous migration studies, however, always ask similar research questions. These prevalent questions are, "Where are people going?" and "Where are people coming from?" with regards to a specific region. To acknowledge why people move from one area to another, there must be a clear understanding of spatial movement and regional migration aspects (Long, 1988). People move for a variety of reasons, whether economic potential elsewhere, change in regional attitude (e.g., politics, people), or because family and friends are moving (McNeil, 1978). When measuring who is participating in the migration, regional aspects such as demographic characteristics (e.g., age, gender, ethnicity, income, education, housing/occupational employment and etc.) are observed. Additional determinants of migration involve marriage, divorce, start of schooling, start of labor, and retirement (Greenwood, 1985; Jones et al., 2007).

According to recent studies and census reports, the rural Midwest and Great Plains (a part of the study area) are seeing an intriguing influx in demographic change (Jones et al., 2007; Parton et al., 2007). In central heartland states, the rural age structure is a concern since death rates have been inclining over birth rates (Jones et al., 2007). This natural decrease in rural population has caused closure in schools, businesses, most noticeably in North Dakota and South Dakota (Loftsgard and Voelker, 1963). As a result, many young age groups move to metropolitan areas. Besides age demographics shifting in these regions, ethnicity has become more diverse. For instance, many Latinos are moving to rural areas by virtue of a lower-wage job market and hard-labor inducing farming opportunities (Jones et al., 2007). Along with demographics, there has also been an adjustment in rural politics and economies. Change in rural policy has seen potential damages to rural life, which include high energy prices, reduction of irrigation, and a loss of environmental integrity (Parton et al., 2007). In order to find solutions to aging populations and policy issues, regional case studies of recent and evolving migrations are influential to the field.

Considering rural transitions pertaining to the mobility of select demographic groups, progression of transportation, machinery and precision agriculture, regional drops in rural population are expected. In Chang's (1974) report, the number of counties with decreased population from negative net-migrations in Iowa is anticipated to expand. Counties with negative net-migration will have more out-migrants than in-migrants, while positive net-migration is vice-versa. Zelinsky (1962) looked at rural counties in two separate components, rural farm characteristics and rural non-farm characteristics, which were divided by the U.S. Census Bureau in 1920. He formed rates of vital statistics in examination with net-population, and found rural-farm areas were predominantly decreasing from negative net-migration, without any major disturbances in birth and death rates. Non-farm counties across the United States gained in population substantially conveyed realistically by a high birth over death rate, rather than the small increase in positive net-migration. However, he interestingly noted that some rural regions did not decrease in population because there are valuable agricultural (rural farm), mineral (rural non-farm), industrial or recreational outlets present.

Migration analyses contribute compelling answers to regional population changes and mobility patterns, which consist of clustering or dispersion. If a region's population is changing due to migration, a determination of the source would be investigated. Referring back to Chang's research article on Iowa's population decline, a region that experienced diminishing populations was in the southern part of the state (Chang, 1974). He realized the southern counties of Iowa are located in an area with lower crop yields on behalf of inadequate soil fertility and prevalent amounts of natural weather hazards. Chang (1974) and Zelinsky (1962) theories collaborated in the fact that many abandoned farm homes are left in inferior farmlands. Rural depopulation in a region could also stem from a breakdown of social ideology, departure of friends, family members, fewer children per household, and loss of regional identity (Zelinsky, 1962; Chang, 1974; Darley, 1978).

Population is a good measurement of regional strength, since rural areas have fewer but specialized functions such as farming crops, along with mining or drilling natural resources (Ullman, 1941). Zelinsky (1962) used a method of structuring town population in a hierarchal form followed by a spatial-temporal analysis of the entire United States. He performed this method to calculate growth of towns in relation to the previous past decades. Loftsgard and Voelker (1963) utilized this technique in North Dakota because the state epitomized regional rural population loss in the Northern Plains. They established a farm service center, a community with a population of around 1,000 to 3,000 people, could provide goods, medical services and schooling. However, towns with a population less than 1,000 were likely to decline throughout the two decades since less economic support was ensuing (Loftsgard and Voelker, 1963). A similar 1941 study in South Dakota, indicated small hamlets with less than 250 people were declining contrary to Loftsgard's and Voelker's 1,000 people (Loftsgard and Voelker, 1963; Ullman, 1941). This research reveals communities with slightly higher populations are slowly depopulating after an arbitrary amount of time.

The design of regions will not be the common configuration of perfectly shaped administrative boundaries. Research investigations that divided regions of the United States used conventional outlines of states, named for their directional placement (e.g., Northeast, Southwest, Central, Northwest, etc.) on a map (Baker; 1931; Zelinsky, 1962; Plane and Mulligan, 1997; Rogers et al., 2003). Instead, a description of regions will be set and counties will be amalgamated, provided the counties follow the rules and criteria for the region based on its description. There are several motives to forming regions with an outlined process even if the shapes are not the typical conveyed cartographic sketch. First, composing regions to resemble an area of physical landscapes, human characteristics, or economic systems by selecting a number of administrative boundaries is a troubling feat. Boundaries parallel to each other might be relatable socially and economically, however, may not fit the region's extent. Second, regions should be accurately developed to validate demographic migration flows concretely. For example, a region that depends economically on labor workers will want to know recent migration flow accounts of men, working age, and Hispanics. An excess migration of one particular demographic to a region could lead to potential social and economic consequences (Baker, 1931). Lastly, with a combination of spatial units making up a region's boundary, the capability of calculating the total number of intra-regional migrants against inter-regional migrates is attainable. Specifying regions to the time-series data is imperative to portray the areas precisely as possible.

2.5 Modern Migration Methods Utilizing Statistical Significance and Spatial Analysis

This following section is a survey of arrayed methods on calculating migration's spatial analysis. Population geographers use these techniques to gain insight on flow visualization, patterns, and hot spots through space yielding statistical results (Roseman, 1971; Fotheringham and Brunsdon, 1999; Rodrique et al., 2006). With migration theories and models advancing, and progress in continual modernized data, this study is warranted, considering regional shifts of migration evolve over arbitrary amounts of time (Greenwood, 1985). Quality migration data needs the following three components (i.e., origin, destination, linkage) to contain adequate flow data (Niedercorn et al., 1969; Thompson, 1974). These factors are the main foundation for viewing flows, transactions, and traffic throughout spatial interaction (Rodrique et al., 2006). Obtained data collections are by no means perfect as reliable flows and coverage are generally excluded due to unfilled sampling information and margin of error (Thompson, 1974). As the U. S. Census Bureau's areal spatial units and added variables become more disaggregated, the available data becomes increasingly complex.

The majority of migration studies that incorporate regional flows are an expansive scrutiny of the entire United States (Baker, 1931; Zelinsky, 1962; Greenwood, 1985). One contemporary migration analysis evaluated in/out migration flows in the Appalachian region (Ludke and Obermiller, 2014). The mathematical difference between in-migration and out-migration is a total estimate of net-migration for an outlined region (Zelinsky, 1962; Chang, 1974; Greenwood, 1985; Yano et al., 2000; Ludke and Obermiller, 2014). Zelinsky (1962) and Greenwood (1985) demonstrated this equation in tables for multiple regions in the United States across long time periods. Zelinsky's West North Central region encompassing the states of Minnesota, Iowa, North Dakota, and South Dakota recorded negative net-migration rates of ten to twenty percent to other United States regions. Comparatively, over twenty years later, Greenwood's North

Central region containing similar states, also established negative net-migration rates with coinciding percentages.

On a finer scale, Ludke and Obermiller (2014) selected states in the Appalachian mountain region to form their study area. Ludke and Obermiller's (2014) primary method was comparing and contrasting migration charts and tables derived from American Community Survey (ACS) data to find the magnitude of net-migrations in this region. Flow data by economic type was explored at a sub-regional, county level to discover if counties were distressed, at-risk, transitional, competitive, or attainment by testing spatial statistics and significance. (Ludke and Obermiller, 2014). The calculation of net-migration produces a result of an area's population change, but absolute numbers are not necessarily the best perspective (Holland and Plane, 2001). Holland and Plane (2001) dispute migrants' net-estimates could give the wrong perspective, when two smaller populated counties are identical to two larger populated counties in close proximity. High in-migrated and out-migrated counties are flawed with a representation of population, invoking the action to calculate net-rates. The Crude Net-Migration Rate of an area is calculated by in-migrants divided by current population (in-migration rate), out-migrants divided by current population (out-migration rate), following a subtraction of out-migration rate (OMR) by the former in-migration rate (IMR) (Holland and Plane, 2001). Ludke and Obermiller (2014) did not use demographic flow data in their regions, instead using household and job-related characteristics. Economic components are frequently applied as the main feature of a migration analysis (Sjaastad, 1962). An early and innovative migration analysis estimated costs and returns of economic investments, over net rates of human migration within the Midwest region (Sjaastad, 1962). Ludke and Obermiller's (2014) research concluded by stating there were no large scale movements, but noticed small gains of migrant workers in pockets going inside the Appalachian region.

The advancement in geo-spatial techniques for geographic research is a tremendous advantage when solving spatial analysis inquires. Spatial analysis consist of spatial data analysis, spatial statistics, spatial interaction, and spatial regression as a few different methods, achieving a vast amount of desired results. These methods utilize geographic, human related data to obtain meaningful findings on a spatial scale. Most spatial analysis techniques dealing with migration cases are performed using a type of spatial interaction method called the gravity model, which is regularly formed with different variables, constraints, weights, and errors to the researcher's preference (Ewing, 1974; Ord, 1975; Haynes and Fotheringham, 1984; Plane, 1984; Bennett and Haining, 1985; Yano et al., 2000; Jang and Yao, 2011; Jang and Yao, 2014).

The next method, spatial autocorrelation, is a type of spatial statistic, which measures estimated flows spatially to determine areas of clustering, dispersion, or randomness (Chi and Zhu, 2008; Chun, 2008; Scardaccione et al., 2010; Pogodzinski and Kos, 2013; Jang et al., 2014). Tobler (1995) stated developments in human migration coincide with the First Law of Geography, by the fact more predominant amount of migrations occur within closer distances than ones that occur further away. Spatial autocorrelation is a measurement of a variable with itself, calculating whether spatial characteristics of values are closer together or are distant (Pogodzinski and Kos, 2013).

Whereas spatial interaction assesses overall flows of the regions, spatial autocorrelation will determine the feature's spatial surroundings and relationship. Knowing the displacement of demographic flows gives clues into separation or a cumulating population groups.

To measure spatial autocorrelation, a method called Moran's I Index can be applied. Moran's I Index is a tool that computes the strength of spatial patterns, measuring any contrasting features having spatial values that are either together or disengaged. When operating the spatial autocorrelation process, there are two forms of measurements to Moran's I index to calculate spatial patterns. First, Global Moran's I is a single statistical output that integrates the whole study area for spatial patterns (Pogodzinski and Kos, 2013; Jang et al., 2014). The other output is Local Moran's I, which takes into account every spatial feature within the bounds of the study area (Pogodzinski and Kos, 2013; Jang et al., 2014). Chi and Zhu (2008) put together a noteworthy analysis of Local Moran's I in Wisconsin, using Minor Civil Divisions (MCDs) as the spatial unit. Chi and Zhu's (2008) method of spatial autocorrelation and the dissection of disaggregated data was effective in drawing out various demographic migrations forming at levels on lower scales. Jang et al. (2014) parceled transportation modes of two different age groupings into census tracts. The demographic age groupings, baby boomers and non-baby boomers, turned out to be significantly different from each other in terms of transportation modes in the St. Cloud area (Jang et al., 2014). In Italy, the clustering and dispersion of foreign migrants were identified using a Local Moran's I equation with a higher weight variable to represent more intense areas (Scardaccione et al., 2010). Human migration and demographic characteristics have often been found applicable with certain types of spatial analysis, making these methods the most appropriate.

CHAPTER 3: METHODOLOGY

3.1 Study Area

The states within the Upper-Midwest consisting of Minnesota, Iowa, Wisconsin, North Dakota and South Dakota, together have a total of 377 counties. Upper-Midwest states vary in definition from person to person, meaning there is no designated outline. These states were chosen in the study area based on connectivity, having multiple defined regional differences and the possibility of rural depopulation occurring in some of the regions within the Upper-Midwest. An overwhelming majority of migration analyses limit the spatial scale to a single administrative boundary at a different spatial unit (e.g., state, county, census tract, MCD). However, in order to look at a region that is not set by borders, forming groups of administrative boundaries would create a profound analysis based on net-migration flows. These five states present a large area for extensive migration distances, yet restrict possible migration intensity.

Normally, the state of Michigan, more commonly the Upper-Peninsula, can be found in the Upper-Midwest. However, the state of Michigan was excluded for two reasons: (a) pre-determined regional boundaries are not connecting with the state. (b) Transportation networks do not flow in the slightest because Lake Michigan separates the main population of the state from the upper-peninsula. Examples of past research or other practical regions to investigate can include areas based on natural resources (oil, coal and metals), areas of a growing metropolitan, areas for a business delivery route, or areas troubled by a natural disaster. Observing intra-regional, inter-regional and net-migration of a classified region would yield interesting results to the area's population based on socio-economic changes.

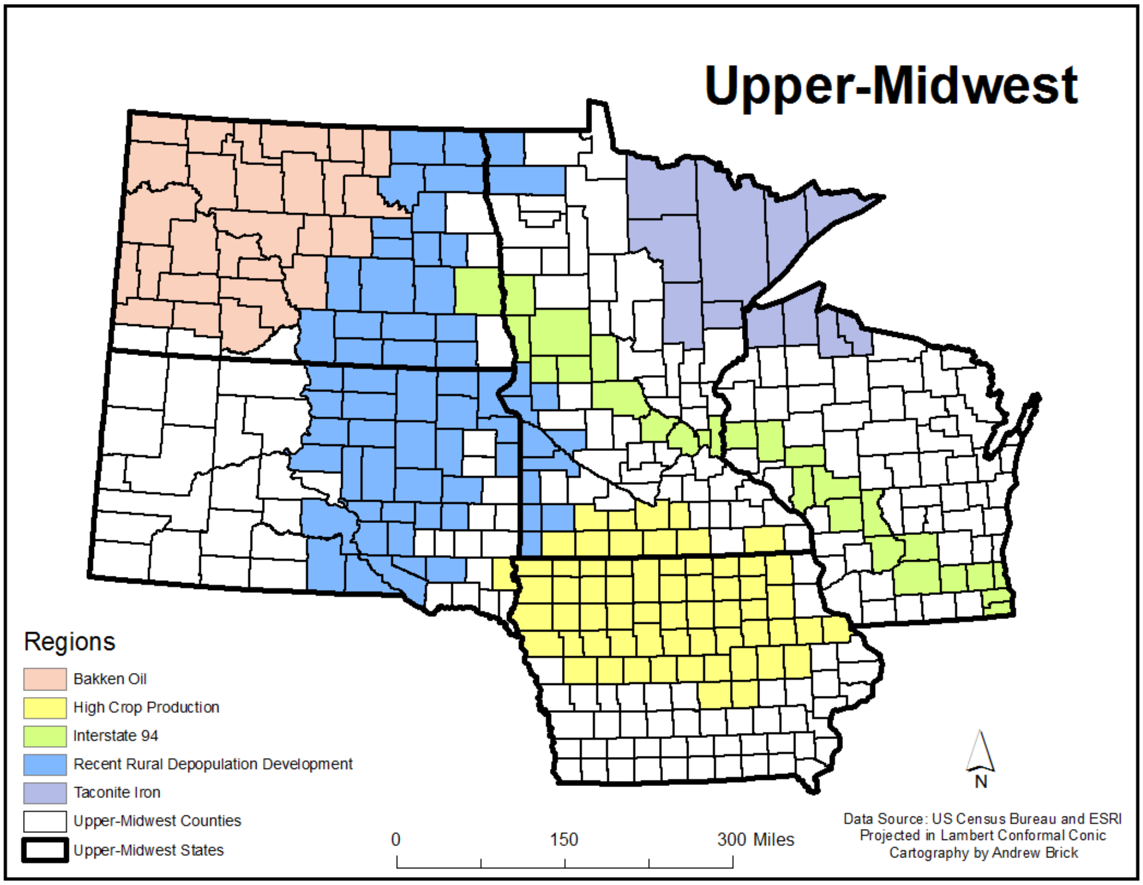

Figure 3.1 Designed Upper-Midwest Regions

Mobility is a fast acting dynamic to the field of geography and with a lack of research in regional migration to the Upper-Midwest, this study aims to discover new regional trends. In Figure 3.1, the Upper-Midwest is shown with five regions being implemented for singular migration analysis. Ludke and Obermiller (2014) analysis did not mention how counties were grouped into regions but the visualization of regions was systematic being separated along state borders and on a directional (e.g., north, south, east, and west) basis. In order to specify a group of administrative boundaries to target a particular region, this study puts in place its first selling point to a migration analysis. A set of criteria was contemplated and carried out for five different regions in the Upper-Midwest. These regions include (a) Bakken oil region, (b) Taconite iron region, (c) high crop region, (d) rural depopulation region and (e) Interstate 94 region (the longest running interstate in the Upper-Midwest). The study area is well-known for agricultural crop production, oil and mining operations, which all provide economic means for rural residents.

The five Upper-Midwest regions encompass both rural (farm, non-farm) and urban areas, which are configured through preconditions set by specifically different attributes denoting a particular region. The counties for each region (see Appendix A) were chosen carefully through available data from academic journals and government websites. The originality of constructing county boundaries, accounting for the true nature of a region is the foundation of this migration analysis. This technique allows for discussion and even further dissection of regional migration patterns, which could expose regional concerns and consequences. This new strategy for spotting regional, demographic patterns, such as clustering, dispersion or randomness is a new challenge that can clarify some types of migration and occurrences. A description on how each region's county makeup was determined, and also why these regions are useful to the study are given throughout. Detailed information can be found in the next section.

3.1.1 Bakken Oil Region

The first initial region will be counties in western North Dakota, which are a part of the Bakken Oil Region, located primarily in North Dakota, Montana and Saskatchewan. The Bakken formation is a portion of subsurface shale and dolomite rock holding oil in the Williston Basin (Mason, 2012). This area of oil is not only relevant in the Upper-Midwest, but for the entire nation, because of the mass amounts of oil being produced there. Drilling in this region started in the early 1950s but intensified in 2006, falling under the study's migration time-series data from 2006-2010 (Johnson, 2013; Mason, 2012). North Dakota's oil production at the start of the time-series in 2006, was near 40 million barrels annually, however at the end of the time-series in 2010, the production escaladed to 113 million barrels (Johnson, 2013). When oil drilling increased, jobs were easily attainable, creating an economic boom and an in-migration spike. Therefore, the migration data will accurately portray the migration event when oil production first began to boom.

Originally, the oil patch did not have determined outlines as portrayed through a variety of contradictory maps by different sources. Despite this issue, a report from the United States Geological Survey (USGS) in 2008 discovered that the Bakken formation is broader than expected. Counties for the migration analysis in the Bakken region were selected from multiple maps stemming from the USGS report, which is posted on their website. The selected counties are labeled as Three Forks Continuous Assessment Units, since it is certain that these counties hold oil-bearing shale at least a mile underneath the surface (USGS, 2008). It is important to note that of the twenty-seven counties, only eleven counties contain oil-producing wells that generated oil in the 2006-2010 timespan. Two reasons why non-drilling counties are included is (a) some of the population that works on the oil fields reside in those counties and (b) counties that produced oil nearby, still economically benefited from increased production. To reinforce the decision on choosing those twenty-seven counties for this migration analysis, they were also defined geographically by the United States Mineral Resources (USMR) and, North Dakota Department of Mineral Resources (NDDMR) in a series of reports and maps (Mason, 2012). The Bakken oil region will be an interesting case study demographically since unemployment rates lowered in 2006 and wages became higher before the recession. It is expected to see a higher male to female ratio and younger demographics since many of these jobs are physically straining. The distribution of ethnic and age groups of in/out migrations will also be intriguing to analyze during the oil boom.

3.1.2 High Crop Region

Along with North Dakota's Bakken oil, another significant area to the United States economically is the Corn Belt that runs through the Dakotas into Ohio. Agricultural production of corn is the most predominant crop in Grain Belt states that include South Dakota, Minnesota and Iowa (Chang, 1974). This region, seen in yellow in Figure 3.1, is formed for its prominent results in high corn production and corn yields in northern Iowa and southern Minnesota. Establishing this region's border was derived from the National Agriculture Statistics Service (NASS) website provided by the United

States Department of Agriculture (USDA). Statistics from NASS are gathered from farmers, ranchers and businesses pertaining to agriculture in a program survey. Within the NASS website, the user selects the desired commodities and categories concerning their research. In this case, this research analysis selected the corn sector for commodity as well as production and yield for categories. From there, the geographical area was tabbed by county for the states of Iowa, Minnesota and South Dakota. Lastly, data was available annually, which led to selecting the year 2005, one year prior to when the migration time-series (2006-2010) data occurred. Prior production and yield data based on the year before the time-series data was preferred, since the counties chosen would represent the area of high corn production preceding up to the migration events most accurately.

Once the production and yield county data was downloaded for Iowa, Minnesota and South Dakota, criteria were determined to establish which counties were distinct to high corn turnouts. All three states are based off production and yield statistics from the state of Iowa, since Iowa is the main contributor of agriculture in the Upper-Midwest. This leads to the first measurement, corn production of counties that harvested at least twenty million bushels of corn in 2005. The twenty million bushels figure was equated as the average of a county's total production in Iowa. The average of twenty million bushels per county is also roughly the amount of corn that ethanol plants process yearly. Along with high corn production if a county had one ethanol plant in 2005, the county was also taken into consideration for being selected. Ethanol plants are sites where a high demand of corn is necessary to increase profits.

The final part of the criteria is counties that received high agriculture yield measurement in 2005. The figure chosen for high yield production was set as the average percent of Iowa's counties, which totaled to 185 bushels per acre. Counties selected to be in the region of high corn production had to meet at least two-thirds of this criterion. However, there was one exception to this rule being counties that were completely surrounded by other counties that did meet the criteria and contained one portion. Seven counties (Black Hawk, Calhoun, Clay, Pocahontas, Dickinson, Floyd, and Hancock) in Iowa were chosen by an exception, in order to make a more defined region. Table 3.1 shows how many counties qualified to be chosen from each state and the total number of counties selected in the region.

Table 3.1 High Crop Region's Classification Category Totals

State Totals of Regional Criteria	Iowa	Minnesota	South Dakota
Total Number of Ethanol Plants	37	14	7
High Corn Production Counties	60	27	5
High Corn Yield Counties	28	12	0
Number of Counties in Region	51	10	1

The distribution of demographic migration is beneficial information to recognize for policy implications, fertility rates and socio-economic progressions. In the Upper-Midwest the generation gap is becoming increasingly evident in rural areas, since younger age groups are migrating to nearby cities and the baby-boomer generation (born between 1946 and 1964) is aging. Rural counties in the Great Plains and Midwest have higher percentages of elderly than any other regions in the U. S. (Jones et al., 2007). The majority of older generations who retire in these regions tend to stay. It is where close social ties and feelings of community exist (Jones et al., 2007). A sense of belonging in northern communities keeps lower percentages of retirees out-migrating to southern locations (Jones et al., 2007). Note that aggregate population totals in the Upper-Midwest may be growing overall, but it does not paint a picture of possible redistribution in urban-rural environment (Rathge and Highman, 1996). In the Upper-Midwest, there is plenty of contrast in human characteristics between rural and urban areas to inspect within each state and region. The Upper-Midwest is an ideal setting for a migration analysis that will embrace new elements to demographic movements.

3.1.3 Interstate 94 Region

Transportation systems and large volumes of travelers have a direct effect on regional growth by means of employment opportunities, tourism and migration (Lichter and Fugitt, 1980). Interstate 94, counties shaded green in Figure 3.1, is a long strip of national highway running through major cities, such as Milwaukee, Madison, St. Paul, Minneapolis, St. Cloud and Fargo. The Interstate 94 region was created to represent counties with urban areas contrary to the four alternative rural regions. Of the top twenty-five most populated cities according to the 2010 census, twelve of them were located along the Interstate 94 highway. The Upper-Midwest's Interstate 94 region was also established to find distinct patterns in ethnic movements, on behalf of the diverse urban environment. Not only is the mobility of ethnic groups in question but that of age and gender related migrations is needed to be addressed too. Different demographic groups migrate to urban areas such as the Interstate 94 region in search of job opportunities, higher education and other socio-economic benefits.

The Interstate 94 counties are comprised of every county in Wisconsin and Minnesota where this particular interstate system runs through. There are fifteen counties in Wisconsin, eleven counties in Minnesota, and one county in North Dakota apart of this stretch of counties. The one county in North Dakota chosen is Cass County, which is where the city of Fargo is located. The Interstate 94 region stopped in Cass County on grounds of the other counties being associated with the Bakken oil region or Rural region. Essentially, the start of the Interstate 94 region begins in Kenosha County and the Milwaukee area and over six hundred miles of highway road to Cass County, North Dakota.

3.1.4 Developing Area of Rural Depopulation Region

The developing area of rural depopulation is a region created to inspect locations that show characteristics of being "rural problem areas", privy to Leonard's migration study (Leonard, 1944). This rural region is similar to the high crop region in terms of size in population. This region will be the only region that shows negative effects of migration since there is a greater out-migration rate than in-migration rate. The total number of counties were determined by counties that were steadily decreasing in total population from 1996-2005. The time span of 1996 to 2005 was chosen because it was ten years preceding the data's migration estimates. In addition, one decade of decreasing population totals would clearly represent a greater flow of out-migration incidents. States that were found to have depopulation events occurring during this time period include central South and North Dakota as well as the furthermost counties of western Minnesota.

The source of the population estimates in Upper-Midwest counties all came from the U.S. Census Bureau's historical content pages, and can be seen at this web address, https://www.census.gov/popest/data/historical/. The collection of data was separated into two parts (Intercensal Estimates 1990-2000 and 2000-2010) and joined together in an excel table. The first time-series collection was State and County Intercensal Estimtes from 1990-2000. Intercensal estimates by definition, is data occurring between censuses in any given amount of time, in this case it was twice a year. The second collection of time-series data was County Intercensal Estimates from 2000-2010. The layout of the datasets was identical in the way they were presented but downloading the data was different. The 1990-2000 estimates was in .pdf form, while the 2000-2010 estimates were in .xls files. The final excel table listed the population estimates in the month of July from 1996 to 2005.

The specifications of the rural region were intended to expose the most prominent counties facing rural depopulation events. Each county in the rural region had to notice decreasing population totals from the beginning of the evaluation in July, 1996 up till the end of July, 2005. The counties that were selected from this precondition also had to meet an annual assessment. If a county increased annually more than five times in the ten year time series data, then the county was disregarded. The rate of five annual increases in a county that has an overall loss in population over ten years, would not accurately portray a county that is depopulating. The final condition to solidify the rural region was that the counties currently meeting the criteria had to at least border two other counties that met the same requirements. These preconditions to the rural region rendered the most arbitrary shaped region in the case study, but still defines a distinct area of a group of counties with a decreasing population.

3.1.5 Taconite Iron Region

The last region based off an area that holds a valuable natural resource is the Iron Range in northern Minnesota. This area is known for being one of the few mining and exporting locations of Taconite iron ore since the late 19th century in the United States. The counties, seen in purple in Figure 3.1, were arranged by either being locations that have mined for Taconite iron, or counties that were proposed to mine iron from 2006-2010, that could possibly be mined in the future. The ranges that are placed in this iron region include the Mesabi Range, Gogebic Range, Vermillion Range, Gunflint Range and the Cuyuna Range. The only current range with open iron mines is the Mesabi Range, which noticed an increase in iron extraction in 2005 from previously suffering economically over three decades. The rebound in mining for taconite iron in 2005 again bodes well for the time-series data. During the period of increase in iron production for the Mesabi Range, the Gogebic Range was in major discussions to start mining and exporting taconite iron itself. With economic growth and greater potential of mining expansion in the area, an analysis of migrations would be valuable by examining certain trends demographically as well as overall movements.

Taconite is a low-grade iron ore and the only type of iron left remaining in the Iron Region of Minnesota from over a century of mining. Currently, only seven mines are active in extracting taconite iron in this region. The majority of the exported iron ore payload goes through Duluth either by train or by large ships across the Great Lakes. All the active iron ore mines and the city hub of iron transport, Duluth, are located in St. Louis County. Six neighboring counties to St. Louis County, which include Cook, Lake, Carlton, Aitkin, Itasca, Koochiching, were selected for the regional analysis, formulating an outlined region known as the Minnesota's Arrowhead. The Arrowhead Region and Iron Region of Minnesota are not interchangeable by any means, but the shape of the regions are notably comparable. However, this analysis is looking at a response of people moving on behalf of taconite iron thriving once again, so the title of this region will remain as the Taconite iron Region.

In the neighboring state of Wisconsin, the Gogebic Range has been found to have taconite iron but was not in operation during the time-series data. The Gogebic Range is located across the northwestern areas of Ashland County and Iron County, a short distance from Duluth, a hub city that ships iron if the region were to inaugurate once again. The last time iron was extracted in the Gogebic Range was in 1967, but in 2010, talks to operate new mines emerged. The analysis of human migration in these counties would be a suitable inclusion to the former counties outlined in Minnesota, since the talks started right at the end of the time-series. Counties added to this region's migration analysis from Wisconsin included Ashland, Iron, Bayfield and Douglas Counties. Bayfield and Douglas Counties do not have any known taconite iron and are not associated with the Gogebic Range but they connect the existing counties. Together these counties neighbor both the Gogebic and Mesabi ranges and would inhere to possible regional net-migration influxes, since residences are close to existing and potential mines. Plans for new taconite mines fell through in 2015, when a business partner backed out and concerns of degrading wetlands came into play.

3.2 Data Acquisition

For this project, county-to-county migration tables were downloaded, which include human characteristics such as demographics, education, income and work statuses. These attributes, attained by the American Community Survey (ACS) were formed into 5-year datasheets of migration estimates based on current and previous residences of 1-year ago. This migration analysis aims to establish certain migration patterns between contrasting groups of people. Therefore demographic data (e.g., age, gender, race and Hispanic/Latino) was the most desired choice since other attributes were formed by different 5-year datasets. The large collection of data gathered is necessary to achieve the goals and answer the research questions. The following list is information on the data resources and websites they are accessed from.

a) The U.S. Census Bureau’s data, found on the internet in America FactFinder section (http://factfinder2.census.gov), is favorable in providing many forms of demographic features, which can be set in different geographic categories (states and counties). Selections of geographic mobility were made based on 5-year estimates from Iowa, Minnesota, North Dakota, South Dakota and Wisconsin. Data from America FactFinder has flexible selection possibilities and data tables are intact with little to no missing measurements.

b) The American Community Survey (ACS), a statistical survey also developed by the U. S. Census Bureau, established Migration/Geographic Mobility tables (http://www.census.gov/hhes/migration/) and it contains county-to-county migration flows. Tables downloaded have three main columns, which include county of current residence, county of previous residence, and flow. Migration estimates from the 2006-2010 samples, are only tabulated by characteristics of age, gender and ethnicity. The population estimates from 2006-2010 are imperative since this source is the only way to import flow data for human migrations. Data is slightly limited due to discrepancies in the 5-year time periods between, education, households and income from 2007-2011 along with employment, occupation and work status from 2008-2012.

3.3 Methodology

3.3.1 Data Preprocessing

The Migration/Geographic Mobility is accessible through the Population section of the U.S. Census Bureau homepage. Navigating into the ACS data, the County-to-County Migration Flows are accessible under Data Tables, Products and Reports. An application available to users below the excel flow estimates is the Census Flows Mapper at http://flowsmapper.geo.census.gov/. The Census Flows Mapper is an interactive mapping system that produces visual representation of migration flows within all counties in the United States. Migration flows chosen in the Census Flows Mapper can indicate all the characteristics associated with a single of group of chosen counties. Statistical facts based on the in, out, net totals pertaining to the selection of migrations flows are also accessibly shown within the Census Flows Mapper.

The Census Flows Mapper is a phenomenal tool to use on large-scale conditions of analysis. This analysis is looking for results that are not capable with the Census Flows Mapper, so a different approach was utilized to control particular data characteristics. This method consisted of manipulating excel data tables to narrow down regional preferences as well as disaggregating age groupings. The formation of multiple data tables into regional areas, classifying a large group of counties from multiple states, is a primary focus of this analysis. A regional study of migration flows in the five Upper-Midwest states can objectively show variance of migration estimates to a specific location, rather than an entire area. Once the region is completely broken down into its selected counties, the limited outreach of in/out migration estimates, allows officials, planners and businessmen to perceive local migration events and issues. This method would give the opportunity to business operations and governments to construct more efficient ideas regarding current migration occurrences.

The U.S. Census Bureau migration/mobility data provides two different types of flow, the first labeled “Current” and the other labeled “Previous.” This separation admits an easier dissection of in-migration and out-migration flows. Besides simply total migration flows, tables are also classified by the rudimentarily named demographic characteristics, consisting of age, sex, race and Hispanic or Latino origin. All together ten different tables were extracted from the US Census Bureau’s *County-to-County Migration Flows: 2006-2010 ACS* section for data selection. The first step after downloading the tables was to consolidate only the necessary information and limit the scope to the states in the study area. The retained data was the known current residence of state and county, known previous residence of state and county, population estimates and flow estimates.

Data that was omitted was columns listing non-movers and margins of error estimates. Note that Margin of error (MOE) is critical for a rigorous, and accurate migration analysis because estimates are only an approximate. Accounting for sampling variability in migration is often applied with MOE but could not be figured into this extensive analysis for a couple of reasons. First, this analysis was simplified for the sufficient losses in rural data leading to flow data being processed free from error. The Upper-Midwest regions would lose even more interaction data if MOE was calculated since a moderate amount of data excluded did not accommodate a previous residence.

Also, it is difficult to produce a truly accurate migration analysis with the overwhelming number of transient movements, which include students and workers on temporary jobs. Preserving as much flow data as possible was essential for this project otherwise data would be drastically discarded and would not have much data to work with.

Another selling point to manipulating excel tables besides subdividing a region is segmenting attributes. As previously mentioned, the age groupings were aggregated from fifteen fields down to five fields, including (a) Children (0 - 17 years), (b) College Age (18 - 24 years), (c) Young Adult (25 - 44 years), (d) Middle Adult (45 – 59 years) and (e) Senior Adult (60+ years). By aggregating the age based migration data and population estimates, age-groupings will provide clearer insight to regional flows and signify any anomalies that can now be made. The management and/or classification of migration characteristics differently are not serviceable to the Census Flows Mapper. Depending on the scope of the migration analysis, this process is possibly time-consuming but acquiring the desired flow data has to be defined this way. When the regional data and the area's characteristics are set appropriately, the datasets are ready for operation in the user's application system. Visualizing aggregated inbound and outbound demographic data is now achievable, for example demonstrating a county's ethnic (Caucasian, African American, Asian, Latinos) migration distribution in a region.

3.3.2 Net-migration

Net-migration is simply the gain (+) /loss (-) of a particular area, without knowing the entire scale of the migrations or the county's population. For example, a county with a high population could have a thin margin in between the total in-migration and total out-migration estimates. Absolute values of net-migration can be efficient when representing some migration events but they are not always accurate. Equation 1 represents CNMR, which is the total net-number of migrants per 1,000 people, taking the area's population as a factor into determining the scale of migrations. One goal of this analysis is to contrast demographic CNMR flows to view any abnormal patterns. CNMR are equated by calculating the In-migration rate (IMR) in Equation 2 and Out-migration rate (OMR) using Equation 3. Within the migration/mobility tables, a formula is constructed, followed by CNMR receiving calculations for every county in the Upper-Midwest.

Crude Net-Migration Rate (CNMR)

$$CNMR = IMR - OMR \tag{1}$$

$$IMR = \frac{M_{In}}{M_{Pop}} \times 1{,}000 \tag{2}$$

$$OMR = \frac{M_{out}}{M_{Pop}} \times 1{,}000 \tag{3}$$

Where: CNMR is crude net-migration rate, IMR is in-migration rate, OMR is out-migration rate, M_{In} is in-bound flow, M_{out} is out-bound flow and M_{Pop} is current population.

3.4.2 Global/Local Moran's I Index

This analysis will achieve its goal of recognizing migration patterns by implementing the Moran's I index tool. Moran's I is a spatial autocorrelation method that identifies values and measures them together in pairs to spot any strengthening's of spatial patterns (i.e., cluster, disperse or random). In this analysis values for Moran's I will be that of CNMR. Moran's I conceptualizes the differences in CNMR values, by the neighbor, of its neighbor, and so on. If the differences in values between neighboring features are less than the differences (-1) between all the features in the study area, then the values of that are dispersed (Pogodzinski and Kos, 2013). Otherwise neighboring values more than the mean values (+1) of the study area are clustered (Pogodzinski and Kos, 2013). The variance of Moran's I across the study area will normalize generating values close to zero indicating the pattern is random. The index outputs consist of three values, the Index value, a z-score and the p-value.

Equation 4 represents the global Moran's I index (measuring spatial autocorrelation), while Equation 5 indicates the sum of all elements of the spatial weight matrix (w_{ij}), Equations 6 and 7 represent the z score (indicating level of statistical significance) and expected Moran's I (comparing the calculated Moran's I and expected Moran's I) respectively (Cliff and Ord, 1981).

Global Moran's I

$$I = \frac{n}{S_0} \frac{\sum_i \sum_j W_{ij}(X_i - \overline{X})(X_j - \overline{X})}{\sum_i (X_i - \overline{X})^2} \quad (4)$$

$$S_0 = \sum_i \sum_i W_{ij} \quad (5)$$

$$Z_i = \frac{I - E[I]}{\sqrt{(E[I^2] - E[I]^2)}} \quad (6)$$

$$E[I] = \frac{-1}{n-1} \quad (7)$$

Where: I is the global Moran's I index, *n* is the number of spatial unit indexed by *i*, X_i is the variable interest in area unit *i*, $\overline{X}$ is the mean of *X*, W_{ij} is the spatial weight matrix, S_0 is the sum of all elements of the spatial weight matrix, Z_i is the z-score, $E[I]$ is the expected value for Moran's I.

Local Moran's I

$$I_i = \frac{X_i - \overline{X}}{S_i^2} \sum_j W_{ij}(X_j - \overline{X}) \quad (8)$$

$$S_i^2 = \frac{\sum_j (X_j - X)}{n-1} - \overline{X}^2 \quad (9)$$

$$Z_{Ii} = \frac{I_i - E[I_i]}{\sqrt{(E[I_i^2] - E[I_i]^2)}} \quad (10)$$

$$E[I_i] = \frac{-\sum_{j=1} W_{ij}}{n-1} \quad (11)$$

Moran's I Indices were calculated using ArcGIS's Spatial Statistics Tools. The Global Moran's I Index's input features class consisted of all the regions in the study area and contained the input field of each demographic CNMR. The conceptualization of spatial relationships was inverse distances, which means the neighbors closest to each other have a larger influence on estimates than those that are farther away. The distance method used was Euclidean distance that simply is a straight distance to two neighboring points. CNMR values were standardized by spatial weights of the weight being divided by the row sum. The same techniques were applied to the Cluster and Outlier Analysis (Anselin Local Moran's I). Local Moran's I yielded significant results of clustering and dispersion to regional migration movements with a variety of demographic types.

CHAPTER 4: RESULTS

4.1 Net-Migration and Mobility Visualization through Regional Migrations

By aggregating the total amount of in-migrants per county as well as out-migrants per county, the subtraction of "out-migrants" to "in-migrants" calculates the net-number of migrants per state, region or county. This method was applied for the state level in the Upper-Midwest. As seen in Table 4.1, Minnesota shows the greatest amount of in and out migrants on account of the reduced flow data only to the Upper-Midwest. Interestingly, net-migrants in Minnesota are negative when paired to their neighboring states. There is a clear outlier between Minnesota and North Dakota having a difference of over 18,000 net-migrants, while the next closest net-migrant difference is 6,000 in Iowa. Investigating the tremendous gap in migrants between the two states was due to the greater number of college-age migrants into North Dakota seeking cheaper out-of-state tuition. This is one of the reasons why Minnesota experiences greater scales of out-migrants within the study area during the 2006-2010 time period. Similar to landscape and population totals to Minnesota, Wisconsin also estimated a net-loss of migrants to Upper-Midwest states.

Of initial regard to rural population, the Upper-Midwest states associated with rural territory, Iowa, North Dakota, South Dakota, all gained migrants from other Upper-Midwest states. Along with job opportunities, these states provide affordable housing, education and lenient tax policies, which are main determinants of in-migration. Iowa's and South Dakota's population endured loss of regional growth by managing to bring in migrants from a wide, extended area throughout the Upper-Midwest. However, these total numbers of net-migrants disaggregated to a county scale will neglect to answer the reasoning of why these anomalies occurred. To overcome the problem, a migration analysis by demographic characteristics (e.g., age, ethnicity and gender) at a regional scale identifies types of manifesting migration patterns, revealing potential causes and effects.

Table 4.1 In- and Out-Migration between Upper-Midwest States from 2006-2010

	Iowa	Minnesota	North Dakota	South Dakota	Wisconsin	Total Out-migration
Iowa	0	25,766	1,405	13,020	14,773	**54,964**
Minnesota	31,828	0	53,740	19,281	88,032	**192,881**
North Dakota	3,962	34,850	0	8,740	2,264	**49,816**
South Dakota	11,688	17,892	7,427	0	2,541	**39,548**
Wisconsin	18,751	86,427	2,081	2,949	0	**110,208**
Total In-migration	**66,229**	**164,935**	**64,653**	**43,990**	**107,610**	**447,417**
Percent Change	20%	-14%	30%	11%	-2%	

Courtesy: U.S. Census Bureau's Migration/Geographic Mobility tables

Aggregating regional flows by demographic characteristics yielded absolute net-migration estimates. A few trends are visible by viewing net-migrations in Table 4.2. The rural Bakken oil region has diminishing net-estimates of females, non-Hispanics, and child aged migrants along with plummeting crude net-rates of Asians, Blacks and college aged migrants. In order to calculate crude net-migration rates, total flow estimates between the known county of current residence, the known county of previous residence one year prior and the county population estimates were configured in Table 4.2 as well. Only Hispanics and young adults who predominately make up the working class in the Bakken oil region have positive net-rates. The remaining demographic groups are understandably migrating outward to seek other job opportunities or social living standard areas. Similarly, the rural region contains negative net-rates to non-Hispanic and college aged migrants, which raise future concerns of preservation with many ethnic movements and younger generations leaving. In contrast, the high crop and Taconite iron regions are demonstrating characteristics of regional growth with promising crude net-rates to other ethnic backgrounds and college aged migrants. These patterns are opposite to the Bakken oil region and rural region, which perceived positive outlooks to the high crop and Taconite iron regions.

Interstate 94 displays the most convoluted mobility patterns in Table 4.2, considering the five Upper-Midwest regions. An uncommon occurrence took place in the Interstate 94 region, where the ratio of net-migrants in the gender demographic contrasted heavily with a surprising large gap. The difference of migrants is nearly seven thousand more departing males than females, who slightly rose in net-migration. This development is likely transpiring due to females holding more service jobs, which are present in urban areas (e.g. healthcare, education, offices, and sales). Jobs such as construction, manufacturing and industrial jobs, which males typically obtain, are out-setting away from larger populations and urban areas. Black and Hispanic migrants recorded the high crude net-rates along with the abundance of negative net-migrants to children and young adults. Black migrations in the Interstate 94 region tend to move in large groups towards nearby counties with suburbs and cities of short distances. The excess amount of children and young adults are in all probability families who also drift to suburban counties away from major highways.

Table 4.2 Regional Net-Migrants and Crude Net-Migration Rate between Demographics from 2006-2010

		Bakken Oil		**High Crop**		**Interstate 94**		**Rural**		**Taconite Iron**	
Demographics	**Type**	Net	CNMR	Net	CNMR	Net	CNMR	Net	CNMR	Net	CNMR
Overall	Total	-1326	-4.41	1715	1.03	-4120	-0.81	-3032	-7.17	2235	5.56
Ethnicity	Asian	-83	-71.06	-333	-16.66	-184	-0.86	10	13.32	192	75.21
	Black	-328	-192.49	244	7.25	-5356	-10.80	61	80.90	-71	-18.17
	Other	-159	-5.11	158	28.38	-1216	-4.64	195	8.69	327	15.14
	White	-809	-3.09	1918	1.24	-141	-0.03	-1711	-4.32	2305	6.20
Hisc/NH	Hispanic	41	9.99	153	2.16	-3038	-9.11	-190	-29.95	97	20.59
	Non-Hispanic	-1206	-4.14	1834	1.15	-3821	-0.81	-1335	-3.72	2656	6.68
Gender	Female	-727	-4.92	421	0.50	357	0.14	-957	-5.14	777	3.85
	Male	-461	-3.10	1159	1.40	-7254	-2.84	-494	-2.64	1976	9.85
Age	Children	-693	-13.08	645	1.75	-4419	-3.79	92	1.64	443	5.77
	College Age	-832	-28.22	2260	12.27	8299	14.90	-1584	-59.33	1530	37.08
	Young Adult	7	0.12	-359	-0.95	-6990	-1.10	123	2.57	649	7.49
	Middle Adult	-3	0.06	-492	-1.59	-3066	-2.83	-120	-1.38	234	2.56
	Senior Adult	-179	-4.55	-91	-0.36	-918	-4.83	94	2.23	-71	-0.86

Courtesy: U.S. Census Bureau's Migration/Geographic Mobility tables. Note that Hisc means Hispanic while NH represents non-Hispanic. Age category is categorized as Children (0 - 17 years old), College Age (18 - 24 years old), Young Adult (25 – 44 years old), Middle Adult (45 – 59 years old) and Senior Adult (60+ years old)

Crude net-migration rates are an idealistic variable to proceed with since it figures population estimates as a weight of migration scales. For each county, crude-net migration rates were equated as the primary value of methods and analysis. Once completed, county crude net-migration rates were ranked by the top three highest percentages in the five regions, and the bottom three percentages of crude net-migrant rates in the five regions. The top and bottom crude net-migration rates were set side-by-side for each region shown in Table 4.3. Between the positive and negative crude net-rates by region there is a lot of frequency for sharply declining or inclining county migrants.

To layout a few examples, starting with the Bakken oil region, Dunn County appears the most for positive crude net-rates. This result is informative and construes the region to rely heavily on its ability to export oil. Dunn County possessed the second most oil drilling locations during this time period and it showed the most growth for demographics of whites, males, females, young adults, and senior adults. Hettinger County and Burleigh County presented the most negative crude net-rates for the Bakken oil region. Displayed in Table 4.3, a gray highlight is revealing Burleigh County as an impending method under scrutiny. Counties discussed shortly in the Results section were represented by distinct calculations of extreme amounts of positive or negative crude-net migration rates. A mixture of reoccurring counties, acquiring the same positive or negative rates, will be showcased as important counties to investigate within the regions. Other counties not attaining expected net-rates will be of relevance and also explored. The course of action involving the principal counties will accumulate the demographic flows and map the distribution of in- and out- migration for the county in question. This technique will answer certain questions about regional interactions and the effectiveness of aggregating regional flows.

Table 4.3 Demographic Crude-Net Migration Rate Characteristics by top/bottom Three Highest Percentages

		Bakken Oil Region				Area of High Crop Production				Interstate 94 Region				Area of Rural Development				Taconite Iron Region			
		Positive		Negative		Positive		Negative		Positive		Negative		Positive		Negative		Positive		Negative	
		County	CNMR	County	CNMR	County	CNMR	County	CNMR	County	CNMR	County	CNMR	County	CNMR	County	CNMR	County	CNMR	County	CNMR
Total	All	Renville, ND	41.28	Hettinger, ND	-57.03	Lincoln, SD	35.82	Poweshiek, IA	-41.41	Dunn, WI	49.03	Grant, MN	-24.28	Sully, SD	65.6	McPherson, SD	-70.59	Douglas, WI	21.04	Iron, WI	-28.57
		Pierre, ND	34.01	Benson, ND	-45.02	Story, IA	34.59	Wright, IA	-36.22	Cass, ND	23.56	Trempealeau, WI	-16.26	Douglas, SD	55.8	LaMoure, ND	-62.56	Itasca, MN	9.25	Lake, MN	-18.05
		Dunn, ND	33.97	Mountrail, ND	37.54	Blue Earth, MN	31.19	Watonwan, MN	-33.06	Stearns, MN	15.55	Todd, MN	-13.26	Sanborn, SD	49.79	Steele, ND	-41.16	St. Louis, MN	8.59	Aitkin, MN	-13.31
Ethnicity	Asian	Morton, ND	569.4	Stark, ND	-467.4	Benton, IA	148.2	Plymouth, IA	-330.1	Wright, MN	95.52	Todd, MN	-158.9	Yellow Medicine, MN	282.1	N/A	N/A	Douglas, WI	124.2	Carlton, MN	-184.08
		Burleigh, ND	47.3	Ward, ND	-7.63	Carroll, IA	147.7	Tama, IA	-238.1	Dunn, WI	75.16	Otter Tail, MN	-121.1	Pipestone, MN	62.5	N/A	N/A	St. Louis, MN	106.5	Aitkin, MN	-71.43
		N/A	N/A	N/A	N/A	Clay, IA	138.3	Bremer, IA	-162	Stearns, MN	58.97	St. Croix, WI	-104.8	N/A	N/A	N/A	N/A	Ashland, WI	32.97	N/A	N/A
	Black	Ward, ND	268.5	Burleigh, ND	-331.7	Cherokee, IA	1000	Marshall, IA	-267.9	Dunn, WI	197.3	Trempealeau, WI	-740.7	Marshall, MN	1000	Chippewa, MN	-60.61	Carlton, MN	187.2	Aitkin, MN	-1285.7
		Burleigh, ND	56.93	Ward, ND	-33.85	Sac, IA	578.3	Waseca, MN	-191.3	Jackson, WI	178.3	Washington, MN	-526.3	Brule, SD	1000	Brown, SD	-18.87	N/A	N/A	St. Louis, MN	-56.99
		N/A	N/A	N/A	N/A	Pocahontas, IA	454.6	Martin, MN	-173.3	Otter Tail, MN	141.3	Juneau, WI	-371.4	Yellow Medicine, MN	950.6	N/A	N/A	N/A	N/A	Itasca, MN	-26.67
	Other	Bottineau, ND	69.18	Morton, ND	-120.9	Blue Earth, MN	188.5	Plymouth, IA	-372.2	Wilkin, MN	154.6	Douglas, MN	-116.2	Edmunds, SD	524.6	Aurora, SD	-300	Lake, MN	130.6	Iron, WI	-830.99
		Grant, ND	61.73	Benson, ND	-28.26	Faribault, MN	149	Palo Alto, IA	-306.1	Todd, MN	107.8	Columbia, WI	-69.58	Walworth, SD	344.8	Walsh, ND	-123	Aitkin, MN	125.6	Carlton, MN	-48.87
		Pierre, ND	46.43	Mountrail, ND	-14.19	Grundy, IA	102	Buchanan, IA	-264.8	Otter Tail, MN	61.17	Grant, MN	-52.63	Douglas, SD	186.1	Pipestone, MN	-101.7	Cook, MN	112.3	St. Louis, MN	-8.18
	White	Dunn, ND	33.13	Hettinger, ND	-55.26	Story, IA	34.8	Poweshiek, IA	-35.36	Dunn, WI	50.64	Wilkin, MN	-14.6	Douglas, SD	33.85	Steele, ND	-38.9	Douglas, WI	18.13	Lake, MN	-20.15
		Wells, ND	16.92	Rolette, ND	-49.46	Lincoln, SD	34.16	Nobles, MN	-27.23	Cass, ND	24.91	Grant, MN	-13.24	Walworth, SD	28.39	LaMoure, ND	-38.89	Bayfield, WI	11.89	Koochiching, MN	-9.38
		Bottineau, ND	16.44	Benson, ND	-42.5	Greene, IA	30.27	Webster, IA	-25.26	Stearns, MN	12.45	Monroe, WI	-12.09	Foster, ND	25.1	Chippewa, MN	-28.85	St. Louis, MN	8.37	Cook, MN	-9.27
Hisc / NH	Hispanic	Williams, ND	64.9	Burleigh, ND	-55.34	Winneshiek, IA	161.6	Plymouth, IA	-467.5	Jackson, WI	160.3	Douglas, MN	-395.2	Edmunds, SD	658.5	Brule, SD	-1125	Lake, MN	252.3	Carlton, MN	-7.89
		Ward, ND	46.12	Morton, ND	-10.67	Palo Alto, IA	150.4	Cherokee, IA	-312.8	St. Croix, WI	135.5	Grant, MN	-98.77	Deuel, SD	144.4	Brown, SD	-146.3	Douglas, WI	29.93	N/A	N/A
		McHenry, ND	33.71	N/A	N/A	Blue Earth, MN	146.2	Buchanan, IA	-119.1	Dunn, WI	99.84	Trempealeau, WI	-85.33	Lincoln, MN	142.9	Chippewa, MN	-136.1	St. Louis, MN	21.37	N/A	N/A
	Non-Hispani	Wells, ND	48.92	Hettinger, ND	-55.26	Lincoln, SD	32.57	Poweshiek, IA	-33.91	Dunn, WI	50.47	Monroe, WI	-13.07	Dickey, ND	147.1	LaMoure, ND	-38.96	Douglas, WI	21.14	Lake, MN	-18.71
		Dunn, ND	30.02	Mercer, ND	-35.29	Story, IA	32.15	Webster, IA	-29.8	Cass, ND	27.02	Washington, MN	-12.6	Walworth, SD	81.98	Steele, ND	-38.9	Bayfield, WI	11.1	Iron, WI	-11.92
		Renville, ND	14.58	Benson, ND	-35.04	Greene, IA	29.99	Wright, IA	-25.38	Stearns, MN	13.91	Grant, MN	-12.14	Douglas, SD	38.31	Pipestone, MN	-26.42	Itasca, MN	9.51	Koochiching, MN	-8.26
Gender	Female	Dunn, ND	29.83	Hettinger, ND	-82.34	Greene, IA	35.48	Bremer, IA	-35.74	Dunn, WI	47.73	Wilkin, MN	-20.99	Douglas, SD	54.04	Steele, ND	-81.26	Bayfield, WI	13.71	Lake, MN	-25.66
		Wells, ND	26.53	Benson, ND	-29.73	Worth, IA	29.57	Poweshiek, IA	-30.98	Cass, ND	27.84	Grant, MN	-13.83	Walworth, SD	31.73	Edmunds, SD	-32.09	Douglas, WI	10.08	Iron, WI	-13.69
		McHenry, ND	30.73	Mercer, ND	-28.33	Story, IA	26.98	Ida, IA	-29.3	Stearns, MN	15.93	Monroe, WI	-13.79	Steele, ND	30.51	Pipestone, MN	-30.64	St. Louis, MN	8.17	Carlton, MN	-10.42
	Male	Dunn, ND	28.92	Benson, ND	-40.47	Lincoln, SD	44.05	Poweshiek, IA	-35.69	Dunn, WI	54.58	Washington, MN	-17	Walworth, SD	114.8	LaMoure, ND	-56.38	Douglas, WI	32.43	Koochiching, MN	-10.35
		Bottineau, ND	25.76	Mercer, ND	-38.47	Story, IA	37.71	Hamilton, IA	-34.22	Cass, ND	22.38	Douglas, MN	-15.47	Foster, ND	34.61	Chippewa, MN	-36.47	Itasca, MN	16.52	Iron, WI	-10.13
		Grant, ND	18.3	Hettinger, ND	-26.08	Blue Earth, MN	25.81	Webster, IA	-30.82	Jackson, WI	15.56	Grant, MN	-12.76	Sully, SD	29.07	Grant, SD	-28.96	Carlton, MN	14.5	Aitkin, MN	-9.73
Age	Children	Grant, ND	106.4	Hettinger, ND	-133.3	Greene, IA	64.23	Poweshiek, IA	-54.9	Otter Tail, MN	26.75	Douglas, MN	-19.89	Walworth, SD	129.7	Grant, Sd	-160.8	Itasca, MN	42.5	Iron, WI	-31.34
		Bottineau, ND	41.59	Burleigh, ND	-51.1	Worth, IA	58.16	Webster, IA	-43.86	St. Croix, WI	12.26	Grant, MN	-16.09	Douglas, SD	93.27	Kingsbury, SD	-38.27	Cook, MN	23.81	Carlton, MN	-20.36
		Wells, ND	41.3	Benson, ND	-13.76	Franklin, IA	43.7	Chickasaw, IA	-37	Dunn, WI	11.65	Hennepin, MN	-14.03	Pembina, ND	43	Rock, SD	-29.98	Bayfield, WI	19.34	Aitkin, MN	-3.85
	College	Wells, ND	192.3	Hettinger, ND	-562	Hancock, IA	128.6	Delaware, IA	-239.5	Dunn, WI	204.6	Wilkin, MN	-190.4	Walworth, SD	218.8	Steele, ND	-942.9	Douglas, WI	73.63	Cook, MN	-105.5
		Renville, ND	80.65	Mercer, ND	-485.9	Story, IA	116.6	Plymouth, IA	-214.2	Cass, ND	117.7	Monroe, WI	-135.8	Foster, ND	151.4	LaMoure, ND	-512.1	St. Louis, MN	64.54	Bayfield, WI	-104.12
		Bottineau, ND	54.58	Burke, ND	-389.8	Black Hawk, IA	113.7	Hamilton, IA	-200.4	Stearns, MN	96.75	Washington, MN	-127.1	Yellow Medicine, MN	112.9	Edmunds, SD	-456.5	Ashland, WI	10.33	Lake, MN	-82.47
	Young Adult	Dunn, ND	133.6	Hettinger, ND	-343.8	Calhoun, IA	57.08	Poweshiek, IA	-223.5	Dunn, WI	30.57	Grant, MN	-40.56	Sully, SD	194.4	Roberts, SD	-183.9	Bayfield, WI	36.84	Koochiching, MN	-91.32
		Pierre, ND	54.34	Mercer, ND	-112.8	Greene, IA	50.21	Osceola, IA	-68.63	Jackson, WI	28.74	Eau Claire, WI	-33.13	Edmunds, SD	178.5	Kittson, MN	-114.9	Douglas, WI	30.15	Iron, WI	-87.64
		Wells, ND	39.26	Grant, ND	-66.92	Hancock, IA	49.02	Winnebago, IA	-56.04	Wilkin, MN	23.81	Stearns, MN	-14.58	Walworth, SD	138.3	Emmons, ND	-110.2	Cook, MN	27	Lake, MN	-13.33
	Middle Adult	Ward, ND	8.12	Morton, ND	-30.93	Cherokee, IA	39.32	Delaware, IA	-31.69	Jackson, WI	9.57	Eau Claire, WI	-14.37	Foster, ND	58.82	Edmunds, SD	-53.06	Cook, MN	35.71	Koochiching, MN	-6.35
		Benson, ND	3.03	Pierce, ND	-13.95	Calhoun, IA	30.1	Buena Vista, IA	-30.96	St. Croix, WI	9.25	Milwaukee, WI	-9.43	Walsh, ND	28.31	Beadle, SD	-33.82	Carlton, MN	19.71	Bayfield, WI	-6.07
		Renville, ND	2.34	Mountrail, ND	-7.41	Franklin, IA	29.55	Hancock, IA	-26.78	Cass, ND	8.16	Sauk, WI	-8.16	Walworth, SD	23.87	Tripp, SD	-25.92	Douglas, WI	16.48	St. Louis, MN	-3.91
	Senior Adult	Dunn, ND	56.45	Benson, ND	-194.2	O'Brien, IA	24.72	Ida, IA	-90	Otter Tail, MN	18.06	Wilkin, MN	-20.09	Logan, ND	55.33	LaMoure, ND	-104.8	Bayfield, WI	23.73	Lake, MN	-95.88
		Morton, ND	11.79	McLean, ND	-41.05	Cherokee, IA	24.07	Crawford, IA	-68.32	Waukesha, WI	11.89	Grant, MN	-15.48	Walworth, SD	49.88	Sargent, ND	-75.22	Koochiching, MN	16.47	Ashland, WI	-22.88
		Stark, ND	11.65	Pierce, ND	-29.92	Chickasaw, IA	23.35	Buena Vista, IA	-62.04	Wright, MN	10.11	Clay, MN	-13.14	Traverse, MN	58.33	Barnes, ND	-53.45	Douglas, WI	3.29	St. Louis, MN	-1.35

Note that Hisc means Hispanic while NH represents non-Hispanic. Age category is categorized as Children (0 - 17 years old), College Age (18 - 24 years old), Young Adult (25 – 44 years old), Middle Adult (45 – 59 years old) and Senior Adult (60+ years old)

4.1.1 Bakken Oil Region

In the Bakken oil region, college age and whites had the greatest contrast between in-migrants and out-migrants, with a negative net-rate of around 800 people. An intriguing aspect of this region shown in Table 4.4 is the balanced net-migration, meaning oil jobs was stable during this time but younger people were choosing college over well-paying jobs close to home. Further analysis on a county level determined statistically different areas where oil producing wells had significance. Overall, the Bakken oil region had a negative net-migration of 1,277 people indicating the region's economy may have suffered from a lack of growth.

Table 4.4 The Ratio of Total and Excluded Flow Estimates in the Bakken Oil Region

Bakken Oil	Characteristics	Current Estimates	Current Excluded	Previous Estimates
Overall	Total	12,544	----	13,870
Ethnicity	Total	7,967	4,144	9,155
	Asian	154	0	237
	Black	62	0	199
	Other	901	678	1,060
	White	6,850	3466	7,659
Hisc / NH	Total	7,967	4,144	9,155
	Hispanic	201	64	160
	Not Hispanic	7,766	4,080	8,995
Gender	Total	7,967	4,144	9,155
	Female	3,677	2,100	4,404
	Male	4,290	2,044	4,751
Age	Total	7,967	4,144	9,155
	Children	1,271	600	1,485
	College Age	2,750	636	3,549
	Young Adult	2,622	1,532	2,615
	Middle Adult	647	822	650
	Senior Adult	677	554	856

Note: Previous Excluded Estimates are unknown due to data unavailable for past residence. Hisc means Hispanic while NH represents non-Hispanic. Age category is categorized as Children (0 - 17 years old), College Age (18 - 24 years old), Young Adult (25 – 44 years old), Middle Adult (45 – 59 years old) and Senior Adult (60+ years old)

Looking at the mobility of a region's population center will provide a picture of the region as a whole. If the migration is high inside of the region, that would be a positive outlook for the regions' economic possibilities. In comparison, if much of the migration is heading outside of the region, then the local economy could be in jeopardy. Figure 4.1 shows the movement of the children based age group in the Bakken oil region. Children (0 - 17 years old) are the future to an area's growth and forecasting the needs for schools, hospitals and other planning necessities. The capital of North Dakota, Bismarck, is the most highly populated town in the Bakken oil region and second in the state. This population center is located within Burleigh County and is a hub to transportation systems for the area's oil resources. The migration of children during 2006-2010 looked to be in a promising stage since the majority of the migrants were balanced throughout the state and many of them coming from eastern Cass (Fargo) and Stutsman (Jamestown) counties. Another benefit from the interaction results is the out-migration of children into many counties in western North Dakota. This result is a good outlook for the Bakken oil region to continually grow and strengthen the economic communities around the oil foundation.

The male gender in the Bakken oil region tends to occupy more physically demanding jobs over females. However, Table 4.2 clearly shows the Bakken oil region is not sustaining or increasing migrations in many counties with known oil fields. Male migrations in Mountrail County were selected based on the minimal level of the crude net-migration rate for males. Pinpointing a meaningful demographic attribute to a region's migration is a perceptive approach to determining any developments on the population or economy. Mountrail County, in 2006-2010, obtained the most oil-producing wells and ought to include an abundance of oil based jobs. However, based on Figure 4.2, there was only a miniscule amount of in-migration to Mountrail from a neighboring county. Small in-migration flows of males in Mountrail County likely means a slow-down of production took place during this time period, especially since males should have a sizeable expansion of migration flows in the region. A couple of other explanations could be oil drilling expanded to nearby counties or there was an abundance of temporary residences that were difficult to monitor. These theories can be proved by the out-migration map, showing the disparity of males to areas inside the region.

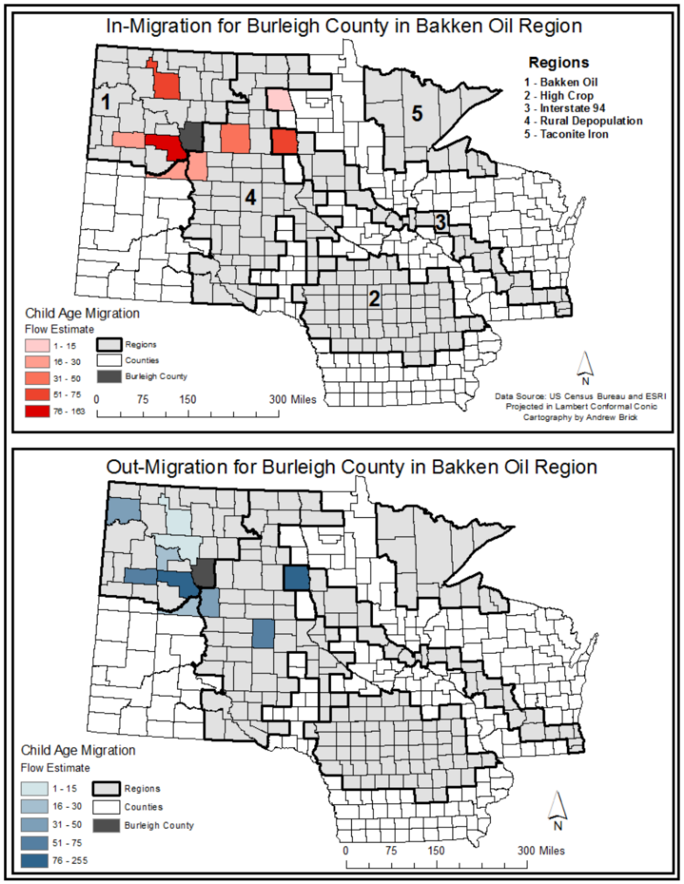

Figure 4.1 Interaction of Child Age Migrations in the Bakken Oil Region

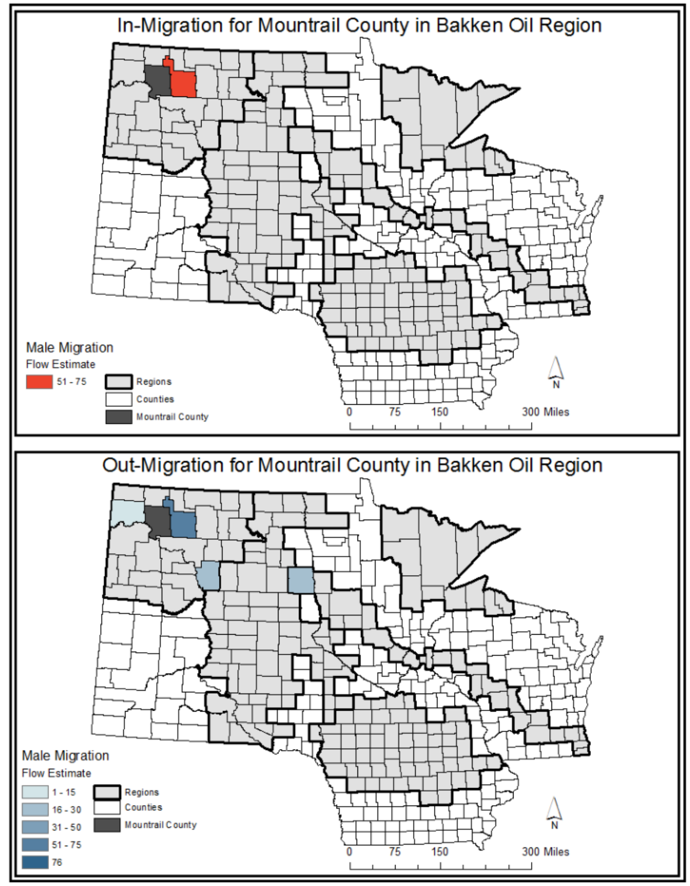

Figure 4.2 Interaction of Male Migrations in the Bakken Oil Region

4.1.2 High Crop Region

The area of high crop production though 2006-2010 was in a period of relative stability. Both inter-regional (i.e., between regions) and intra-regional (i.e., within regions) migrations appeared to be similar in margin of net-migrations with no glaring anomaly in Table 4.5. With the agricultural region having the most counties, an in-depth look at single counties with greater net-migration disparities may exhibit some discrepancies in the perception that migration stability transpired. Both the high crop production region and Bakken oil region are predominately rural, but had a few conflicting demographic net-migration estimates. College age (18 - 24 years old) and whites had a positive net-migration rate in the high crop region, while the working age (young adult) recorded a negative net-migration value. The high crop region by itself possesses conventional notions of rural migration patterns, however differs too with a few atypical traits.

Table 4.5 The Ratio of Total and Excluded Flow Estimates in the High Crop Region

High Crop	Characteristics	Current Estimates	Current Excluded	Previous Estimates
Overall	Total	76,072	----	74,392
Ethnicity	Total	52,031	22,670	50,044
	Asian	545	128	878
	Black	1,931	918	1,687
	Other	2,126	1,070	1,968
	White	47,429	20554	45,511
Hisc / NH	Total	52,031	22,670	50,044
	Hispanic	2,148	1,674	1,995
	Not Hispanic	49,883	20,996	48,049
Gender	Total	52,031	22,670	50,044
	Female	25,159	10,870	24,331
	Male	26,872	11,800	25,713
Age	Total	52,031	22,670	50,044
	Children	9,278	4,404	8,633
	College Age	22,125	8,305	19,865
	Young Adult	13,347	5,831	13,706
	Middle Adult	4,204	2,307	4,696
	Senior Adult	3,077	1,823	3,144

Note: Previous Excluded Estimates are unknown due to data unavailable for past residence. Hisc means Hispanic while NH represents non-Hispanic. Age category is categorized as Children (0 - 17 years old), College Age (18 - 24 years old), Young Adult (25 – 44 years old), Middle Adult (45 – 59 years old) and Senior Adult (60+ years old)

The second fastest growing county in the high crop region is Story County, Iowa. In fact it is the fastest growing county in the entire Upper-Midwest that holds a population of over 50,000 people. Story County and the city of Ames are known for the state's largest university, Iowa State University. With the third highest crude-net migration rate among females, the migration pattern of Story County suggests females are migrating from rural counties to counties with universities to further their academic careers across the Upper-Midwest. This can be revealed in more Upper-Midwestern counties and rural regions than just Story County. Displayed in Figure 4.3, the interaction of in-migrating females contrasts significantly to the interaction of out-migrating females in Story County. Females are in-migrating to Story County from distances farther away, seen across the whole state of Iowa and even into the larger cities of Minnesota. Surrounding counties bordering Story County have an intense in-migration flow amount, which are counties' predominantly rural and agriculturally orientated.

The majority of out-migration rates from Story County are limited to counties in close proximity. Also, levels of out-migration to Minnesota are not near to the rate of in-migrants from the same areas. Furthermore, estimates of out-migration in the northwestern section of Iowa have completely evaporated compared to the in-migration side of the map. This interaction of flow data across the agricultural region implies females are often residing permanently to cities and college towns rather than relocating back to ag-related communities.

Hispanic/Latino population groups through recent studies have been migrating more to rural areas. The interaction maps of Hispanic/Latino population groups in Blue Earth County, Minnesota have verified this fact with another piece of evidence, but a new trend looks to be taking place. First, starting with the Blue Earth County out-migration map at the bottom of Figure 4.4, Hispanics/Latinos appeared to have moved to counties with larger cities, which include Hennepin County (Minneapolis), Ramsey County (St. Paul), and Minnehaha County (Sioux Falls). However, flow out-migration estimates are modest compared to the in-migration estimates into Blue Earth County. In fact, Blue Earth County migration rates are three times greater for relative in-migrant flows of Hispanics/Latinos than out-migrating. In-migration counties into Blue Earth County are stemming from the Twin Cities metropolitan but also unexpectedly transpiring from neighboring high crop counties too. The influx of Hispanics/Latinos to Blue Earth County from rural areas and larger urban areas in Minnesota was to take advantage of the increased economic potential Blue Earth County offered at the time.

Besides the fact that Blue Earth County has the third highest crude-net migration rate among Hispanics/Latinos in the high crop region for agriculture, a fair amount of the in-migration is coming from more agriculturally-based rural counties. This migration sequence indicates Hispanic/Latino groups are locating to Blue Earth County as a place of extended residence. This statement can be confirmed since the majority of the estimated populations of 1,566 Hispanics/Latinos were non-movers. If Hispanics/Latinos are migrating away from high crop counties, depopulation in this region could be a possible scenario because Hispanics/Latinos immigration accounts for a substantial amount of rural growth. This pattern may not be a trend across the high crop region, since the phenomena of Hispanics moving from rural to urbanized counties was against the perceived norm during 2006-2010, further investigation would have to be required.

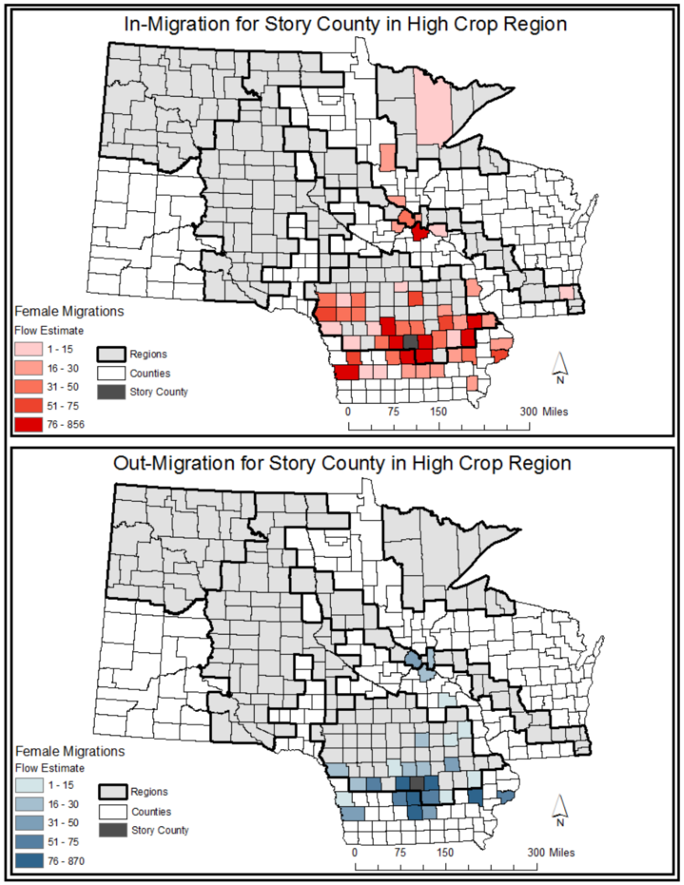

Figure 4.3 Interaction of Female Migrations in the High Crop Region

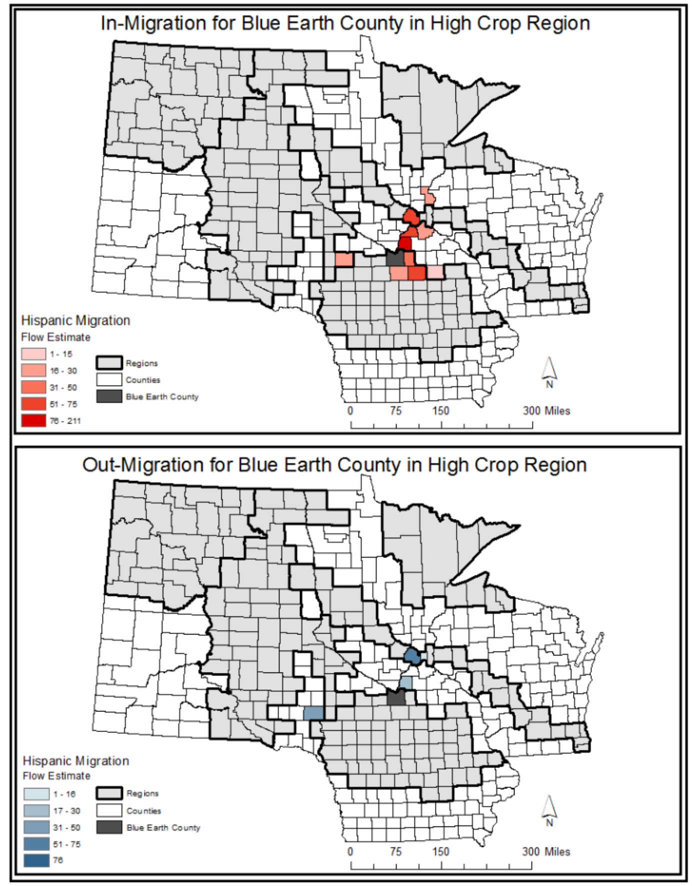

Figure 4.4 Interaction of Hispanic Migrations in the High Crop Region

4.1.3 Interstate 94 Region

Compared to the four rural regions, the primarily urban region of Interstate 94 presents some quizzical net-migration estimates in Table 4.6. The total net-loss of 4,159 migrants is a small figure considering the grand scheme of overall migrations and total population for this region. Thereupon, all four ethnic classifications rendered negative net-migrants, including the Hispanic and Latino groups along Interstate 94. Hispanic/Latino and blacks noticed an exceedingly higher percentage of negative net-migrants than the Asian and white counterparts moving outside the Interstate 94 counties. Meanwhile, the age classification shed light on existing beliefs, in which college age students (18 - 24 years old) are migrating towards urban areas, while children (0 – 17 years old), young age (25 – 44 years old), middle age (45 – 59 years old) and senior age (60+ years old) are moving outside and in large quantities. As suburban and peripheral counties next to urban counties grow, the cities on transportation lines will have populations trickle outside to fringe counties. Whereas the age groups, children, young adults, middle adults, and senior adults were evidently out-migrating from the Interstate 94 region, a sharp spike in college age migrants moved into the existing urban areas. The college age group and females were the only migrants to have positive net-migration results in the urban region. The ratio of gender migrants within the Interstate 94 region offered another perplexing result, in which the total number of net-females was 357, while on the contrary, the dissimilarity of net-males estimated at a negative 7,254 rate. This dramatic shift in gender migrations is likely occurring based on the type of service jobs available in urban areas, university programs, as well as the favorable social atmosphere urban counties offer.

Table 4.6 The Ratio of Total and Excluded Flow Estimates in the Interstate 94 Region

Interstate 94	Characteristics	Current Estimates	Current Excluded	Previous Estimates
Overall	Total	211,398	----	215,557
Ethnicity	Total	191,461	19,136	198,358
	Asian	9,064	296	9,248
	Black	14,692	877	20,048
	Other	9,411	775	10,627
	White	158,294	17188	158,435
Hisc / NH	Total	191,461	19,136	198,358
	Hispanic	8,566	757	11,604
	Not Hispanic	182,895	18,379	186,754
Gender	Total	191,461	19,136	198,358
	Female	94,176	9,183	93,819
	Male	97,285	9,953	104,539
Age	Total	191,461	19,136	198,358
	Children	27,245	2,909	31,567
	College Age	73,681	7,704	65,282
	Young Adult	62,901	5,242	69,891
	Middle Adult	16,772	1,611	19,838
	Senior Adult	10,862	1,670	11,780

Note: Previous Excluded Estimates are unknown due to data unavailable for past residence. Hisc means Hispanic while NH represents non-Hispanic. Age category is categorized as Children (0 - 17 years old), College Age (18 - 24 years old), Young Adult (25 – 44 years old), Middle Adult (45 – 59 years old) and Senior Adult (60+ years old)

With the third highest crude net-migration rate among Asians in the Interstate 94 region, Stearns County exhibits a very compelling migration trend. The tendency of Asian in-migrants to Stearns County is directly correlated with other Interstate 94 counties seen by the straight line the flow estimates formed in Figure 4.5. The bulk of in-migrants ensue from the Twin Cities 7-County Metro Area. Nonetheless, this occurrence reveals Asians tend to migrate toward neighboring cities with direct lines of transportation in the Upper-Midwest.

The same outline and directional flow pattern of migrants can be identified from the out-migrants moving away from Stearns County. Even though the flow estimates of out-migrants are substantially less than the in-migrants along the Interstate 94 region, a similar shape of directional movement still exists. The reason why Stearns County does not have a high outflow rate is because the area is diverse with a growing university and increasing number of businesses. This socio-economic landscape is accommodating for Asian lifestyles designating Stearns County as a satisfying place of residence for Asians. The out-migration of Asians migrants is also visibly a bit more disperse, moving into a couple counties in the Taconite iron region.

Perhaps the most thought-provoking trend of demographic migrations in the Upper-Midwest is of African Americans apparent movement away from the Interstate 94 region (see Figure 4.6). For example, this interaction map presents the abundant amount of African American migrants moving from Washington County, Minnesota. The crude net-migration rate of -526.23, is visibly seen in the out-migration map with the red shadings of nearby counties in comparison to the in-migration map. Otherwise, there is a similarity in the counties on both sides of the map signifying migrations are occurring in urban areas at different degrees of mobility. The belief many African Americans move together in close-knit groups is evident in urban areas of the Upper-Midwest.

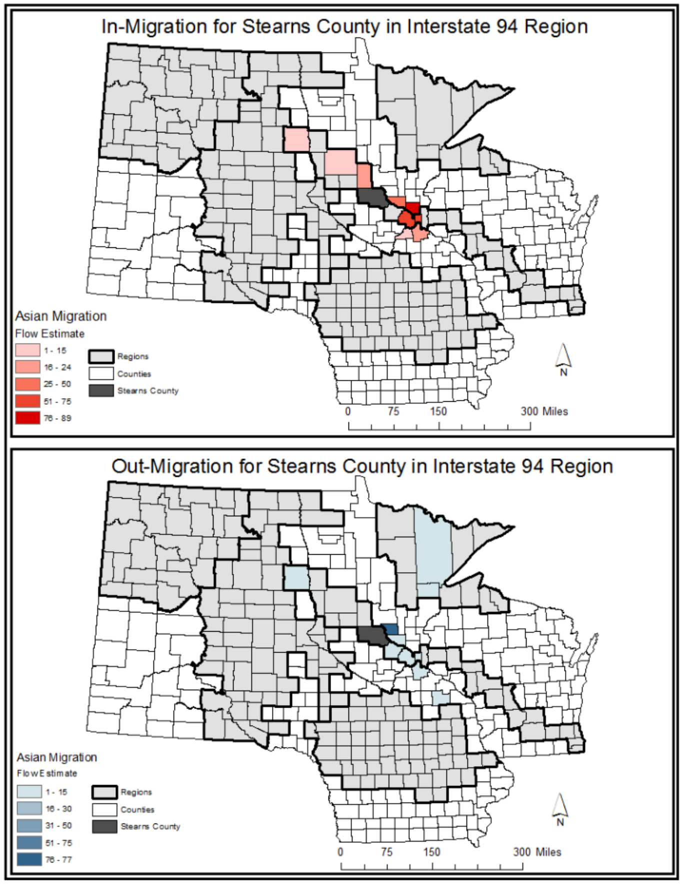

Figure 4.5 Interaction of Asian Migrations in the Interstate 94 Region

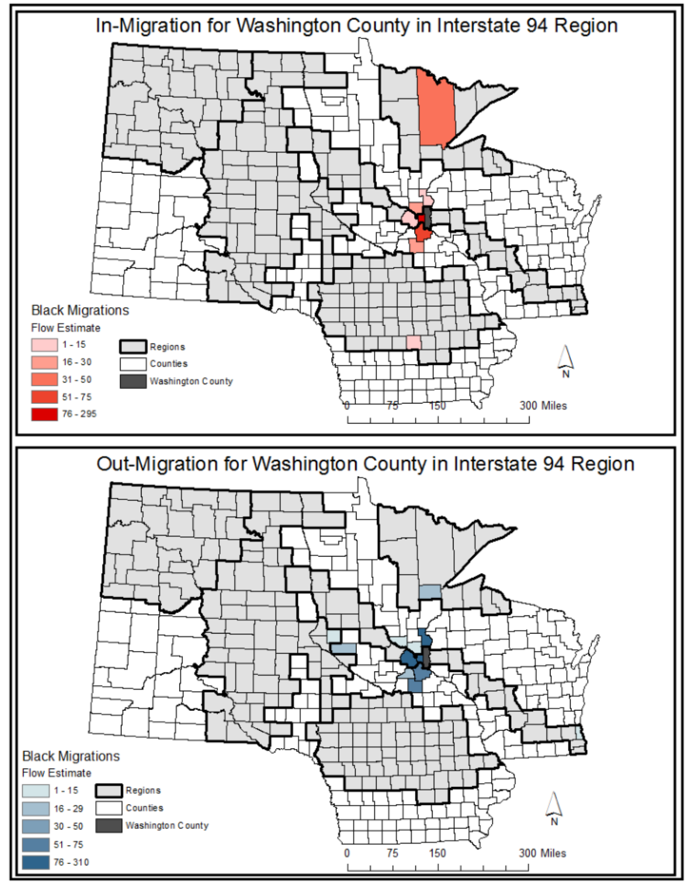

Figure 4.6 Interaction of Black Migrations in the Interstate 94 Region

4.1.4 Developing Area of Rural Depopulation Region

For each demographic category in the region comprised of counties with rural population loss, there were a high number of migration counts that were excluded due to a lack of data. This is an unfortunate circumstance since this region is not going to be accurately portrayed as initially proposed. Out-migration was still definitive by totaling net-migration estimates. Counties in the area of developing rural depopulation recorded on average a fifteen percent decrease in net-migration, during the 2006-2010 time period, shown in Table 4.7. The majority of rural counties did not have many residences to begin with having an average population of 6,823 per county.

Table 4.7 The Ratio of the Total and Excluded Flow Estimates in the Rural Region

Rural	Characteristics	Current Estimates	Current Excluded	Previous Estimates
Overall	Total	15,036	----	18,071
Ethnicity	Total	6,168	7,509	7,619
	Asian	45	73	35
	Black	119	184	64
	Other	883	1,048	688
	White	5,121	6,204	6,832
Hisc / NH	Total	6,168	7,509	7,619
	Hispanic	184	284	374
	Not Hispanic	5,984	7,225	7,245
Gender	Total	6,168	7,509	7,619
	Female	2,919	3,750	3,876
	Male	3,249	3,759	3,743
Age	Total	6,168	7,509	7,619
	Children	1,405	1,488	1,313
	College Age	1,437	2,256	3,077
	Young Adult	1,967	2,184	1,844
	Middle Adult	537	781	657
	Senior Adult	822	800	728

Note: Previous Excluded Estimates are unknown due to data unavailable for past residence. Hisc means Hispanic while NH represents non-Hispanic. Age category is categorized as Children (0 - 17 years old), College Age (18 - 24 years old), Young Adult (25 – 44 years old), Middle Adult (45 – 59 years old) and Senior Adult (60+ years old)

With the second lowest crude-net migration rate in the rural region, LaMoure County featured intriguing interaction results compared to other rural counties in Figure 4.7. By viewing the in-migration estimates of the total population into LaMoure County, it seems that migrations are extremely scattered and undoubtedly random. A good chunk of these counties that show in-migrating flow estimates are from other neighboring rural counties and rural counties from farther away in South Dakota and the Bakken oil region. It is noteworthy to mention that all of the in-migrating counties displayed have low flow estimates.

Moreover, the total mobility of out-migrants arranged differently than the in-migrants. Total out-migration away from LaMoure County was greatest to other counties (e.g., Stutsman County, Brown County, Beadle County) in the rural region that are on the higher end of population for this region. Other locations that recorded LaMoure County's out-migrants included in-state counties with highly populated cities, such as Cass County (Fargo), Grand Forks County (Grand Forks), and Richland County (Wahpeton). LaMoure County's crude-net migration rate of the total population express an area that is in need of development to maintain its communities and local businesses.

Situated in the heart of the rural region is Brown County located in northern section of South Dakota. Brown County's largest city is Aberdeen, which is home to the state's fourth largest university, Northern State University. A look into college-age groups in the rural region would be an effective approach to determining the region's stability. This proposal is especially interesting based on the county's negative crude-net migration rate of -4.98. As seen in Figure 4.8 (the interaction map denoting out-migrations), college-age residents of Brown County opted to move towards counties with other universities. The counties illustrated in light and dark red in eastern South Dakota include Codington County (Lake Area Technical Institute) Brookings County (South Dakota State University), Minnehaha County (Southeast Technical Institute, Augsburg College and University of Sioux Falls), and Clay County (University of South Dakota). The mobility of college-aged students to these universities does not bode well for the rural region to preserve any population efforts. Northern State University can be seen in Appendix B, among other universities and major cities discussed throughout.

Considering the in-migration of college-aged migrants into Brown County is equal to those of out-migrants, it is less surprising to see many of the neighboring counties are moving into Brown County (see Figure 4.8). The surrounding area does not have any post-secondary schools attracting people of college-age to move towards Aberdeen and Northern State University. This interaction of college-aged migrants in Brown County is a complex predicament pending the balance of out-migrants tips any further.

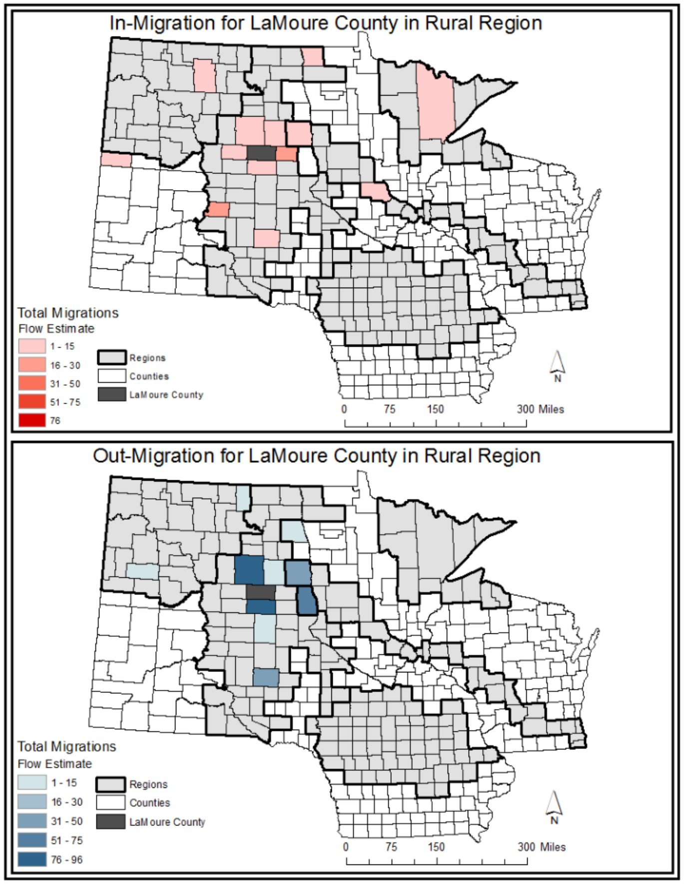

Figure 4.7 Interaction of Total Migrations in the Rural Region

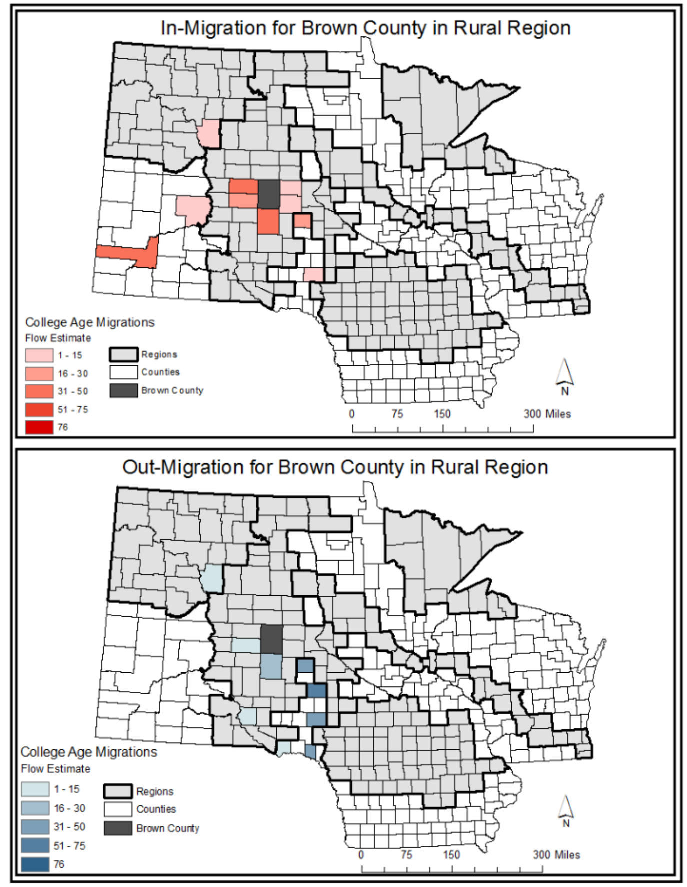

Figure 4.8 Interaction of College Age Migrations in the Rural Region

4.1.5 Taconite Iron Region

The Taconite iron range is the only region that has seemed to have consistent amounts of positive in-migration in the majority of its demographic sectors. The growth of populations and economic sectors in the Taconite iron region is a realistic outlook with these traits. Asian and Children in Table 4.8 have the highest percentage of in-migration than any of the other focal areas. Together, both demographic types point towards a bright future with the region's education system.

Table 4.8 The Ratio of Total and Excluded Flow Estimates in the Taconite Iron Region

Taconite Iron	Characteristics	Current Estimates	Current Excluded	Previous Estimates
Overall	Total	18,180	----	15,937
Ethnicity	Total	14,114	3,926	11,361
	Asian	344	7	152
	Black	355	80	426
	Other	1,414	310	1,087
	White	12,001	3,529	9,696
Hisc / NH	Total	14,114	3,926	11,361
	Hispanic	253	53	156
	Not Hispanic	13,861	3,873	11,205
Gender	Total	14,114	3,926	11,361
	Female	6,225	1,818	5,448
	Male	7,889	2,108	5,913
Age	Total	14,114	3,926	11,361
	Children	2,115	407	1,672
	College Age	5,559	663	4,029
	Young Adult	4,137	1,496	3,488
	Middle Adult	1,490	616	1,288
	Senior Adult	813	744	844

Note: Previous Excluded Estimates are unknown due to data unavailable for past residence. Hisc means Hispanic while NH represents non-Hispanic. Age category is categorized as Children (0 - 17 years old), College Age (18 - 24 years old), Young Adult (25 – 44 years old), Middle Adult (45 – 59 years old) and Senior Adult (60+ years old)

With the second largest net-gain for young adult migrants in the Taconite iron region, Douglas County recovered slightly from years of a steadily decreasing population. Superior, the county's most populated town is a key component to the taconite iron community since it is a transportation hub for the iron to be brought in by trains and exported by cargo ships. The towns of Duluth and Superior both attract workers and businesses because of transportation related jobs. This is evident since the In-Migration map in Figure 4.9 shows young adults moving from cities of further distances into Douglas County. One of Douglas County's main attractions is that there is more available land area to build-up than across Saint Louis Bay in Duluth where land is utilized or inhabited.

The interpretation that jobs bring in young adults (25 – 44 years old) to the port counties of the Taconite iron region is justified since the out-migration interaction shows estimates moving to counties that are neighboring or of closer distances. Young adults conceivably can still work in Douglas County granted that they moved to a nearby county for other influences. Flow estimates to St. Louis County and Douglas County have a greater crude net-migration rate than counties that operated open taconite mines such as Itasca, Aitken, and Lake Counties. Itasca County still held a high positive crude net-migration rate (CNMR) for young adults where the majority of the mines are located, meaning jobs are continuing to thrive even if it is not at the rate to previous decades. The Taconite iron region portrayed by interaction maps seemingly depicts a region prospering economically from an abundant amount of young migrants moving towards counties with iron related jobs.

In the Arrowhead of Minnesota, iron ore is not the only profitable service St. Louis County has to offer. Out-of-state tourists and locals looking for a weekend getaway congregate all year long to the Northern Shores for a retreat. St. Louis County sees a lot of activity in migration on account of seasonal jobs, a growing university and the attractive livability. In-migrants are shown to be moving broadly across the Upper-Midwest in Figure 4.10, with counties in western North Dakota and South Dakota as well as pockets across the state of Wisconsin. The farther migrants move to St. Louis County, the less concentrated and total flow estimates become. In-migration to St. Louis County is most prevalent in the Taconite iron region itself and also in the Twin Cities metropolitan area and along the Interstate 94 region. There are also a handful of counties that show in-migration to St. Louis County from the remaining Bakken oil, Rural and Agricultural region.

On the other hand, out-migration distribution of migrant flows is completely different than in-migration flows. The total number of counties out-migrated is not nearly to the extent of in-migrants, which is sensible since the county noticed an overall total of 1,696 more positive net-migrants. Within the Taconite region, out-migration totals from St. Louis County are distinctly less than the total amount going into the center of the region. Out-migrants who do move to counties farther away are residing in counties with cities with higher population totals. This form of migration supports a geographic distribution pattern known as the hub-and-spoke structure, where small villages tend to migrate to nearby, larger towns and cities, while migrants from those cities tend to move to the largest hub of a region.

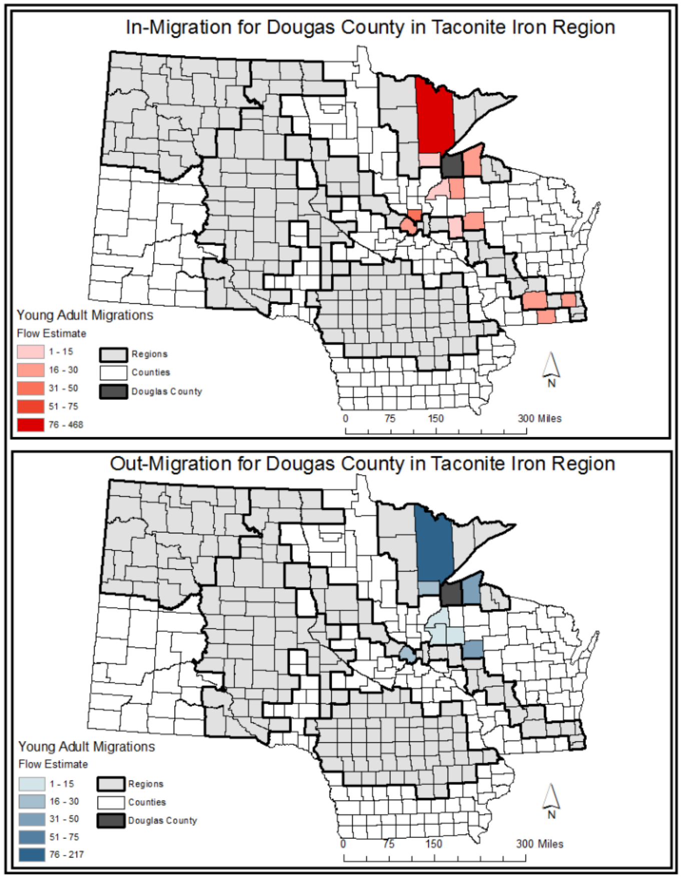

Figure 4.9 Interaction of Young Adult Migrations in the Taconite Iron Region

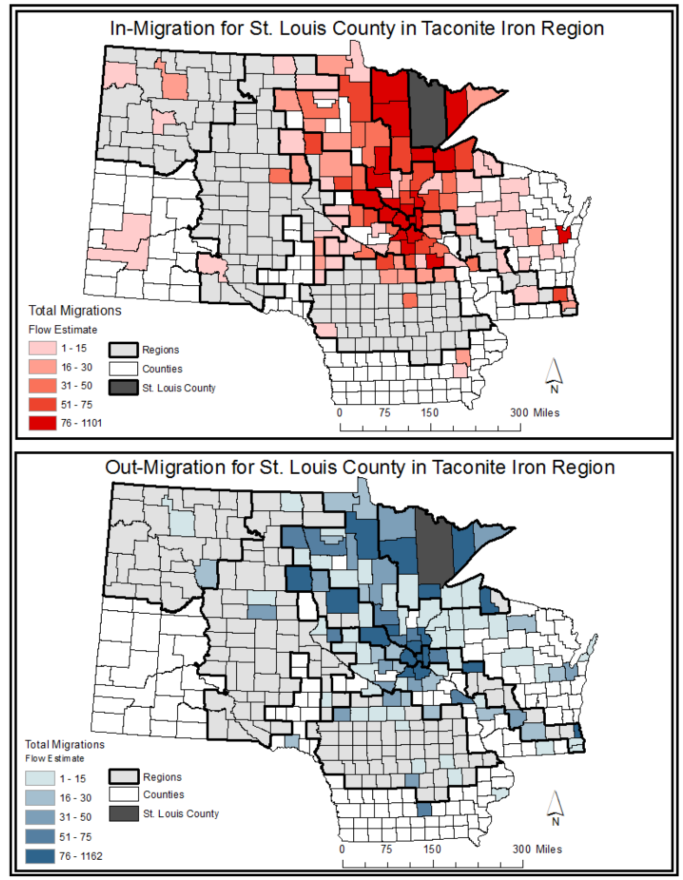

Figure 4.10 Interaction of Total Migrations in the Taconite Iron Region

4.2 Spatial Autocorrelation (Moran's I Index)

Global Moran's I index can detect the strength of spatial patterns (i.e., cluster, disperse or random). The null hypotheis in the Global Moran's I states that there is no spatial pattern (i.e., random). Both p-value and z-score can be applied to the hypothesis test. If the p-value is statistically significant (i.e., the p-value is smaller than significant levels) and the z-score is positive, then the spatial distibution of migration is clustered. A dispersed pattern can be revealed if the p-value is statistically significant and the z-score is negative. If the p-value is not significant, then the spatial distribution is random. Note that significant levels are 0.1, 0.05 and 0.01 respectively. Any p-value smaller than 0.1 is 90% significant, p-value smaller than 0.05 is 95% significant and lastly p-values smaller than 0.01 is 99% significant.

Based on the global Moran's I analysis (see Table 4.9), Asian migrants show 90% significance of dispersion, while the age groups are the most statistically signifant. Children and young adults both demonstrate signifance values over 99% but they differ in the fact that children are dispersed and young adults (25 - 44 years old) are clustered. Other signifance values above 95% include college age migrants and senior adult migrants. As before the characteristics contrast as college age migrants are dispersed and the senior age migrants are clustered.

Table 4.9 Spatial Autocorrelation (Global Moran's I)

	Type	Moran's I	Z-Score	P-Value	Significance
Total	All-migrations	0.0024	0.1806	0.8567	
Ethnicity	Asian	-0.0489	-1.7237	0.0848	*
	Black	-0.0059	-0.1188	0.9054	
	Other	-0.0060	-1.2119	0.9035	
	White	0.0219	0.8887	0.3741	
Hisc/NH	Hispanic/Latino	-0.0250	-0.9192	0.3580	
	Non-Hispanic	-0.0378	-1.2890	0.1974	
Gender	Female	0.0011	0.0564	0.9550	
	Male	-0.0203	-0.6379	0.5235	
Age	Children	-0.0785	-2.7662	0.0057	***
	College Age	-0.0608	-2.1054	0.0353	**
	Young Adult	0.1276	4.7354	0.0000	***
	Middle Adult	-0.0291	-1.0109	0.3121	
	Senior Adult	0.0634	2.4715	0.0135	**

Note: * ($p < 0.1$), ** ($p < 0.05$), *** ($p < 0.01$). Hisc means Hispanic while NH represents non-Hispanic. Age category is categorized as Children (0 - 17 years old), College Age (18 - 24 years old), Young Adult (25 – 44 years old), Middle Adult (45 – 59 years old) and Senior Adult (60+ years old)

Though the global Moran's I index can tell the spatial distribution (i.e., cluster, disperse or random) as a whole, it does not indicate which area is statistically different. To overcome the problem, the local Moran's I index (or Anselin Local analysis) is applied. Outputs of the local Moran's I index visualize the county's statistical significance by four different classifications (i.e., HH, HL, LH and LL). The first classification is High-High (HH) type, which signifies cluster of high values. The next type High-Low (HL) expresses an outlier where a high value is surrounded by low values. The third type is High-Low (LH), which is the opposite of HL, indicating an outlier in which a low value is surrounded by high values. Finally, the Low-Low (LL) classification type means the feature is a cluster of low values. Anselin Local Moran's I classification types only appear in counties that are composed of the five focused regions shaded in gray. Different demographic types yield a unique contrast of clustering and outliers throughout the Upper-Midwest regions.

Beginning with Asian migrants and its spatial distribution in Figure 4.11, displays only two counties, Wilkin County and Otter Tail County with significant values. This result is appropriate to the analysis of previous interaction data of in-migrants and out-migrants since migratory trends of Asians predominately occurred in the Interstate 94 region, where both of these counties are situated. Both counties are outliers to each other, stating that spatial patterns in that area are conflicting between Wilkin County and Otter Tail County. One possibility to Wilkin County and Otter Tail County being neighboring outliers is the small percentage of population these counties hold compared to the other Interstate 94 counties. Any substantial neighboring values would be prone to causing results that are statistically different.

Anselin Local Moran's I turnout of African American trends in Figure 4.12 produce some unanticipated results. A section in the western part of the high crop region render three counties (i.e. Buena Vista County, Calhoun County, and Clay County) with high valuing clusters. Black migrants tend to gravitate towards each other explaining the reason for the high clusters in western rural Iowa, where black population is relatively small. African Americans distinctly move in groups more so than other ethnic group in northern cities (Tolnay, 2003), which was validated by the interaction maps. This leads to another area of interest, Washington County, where the interaction of in-migrants and out-migrants was previously investigated (see Figure 4.6). Washington County is represented as an outlier with a low value of in-migrants as the neighboring counties contain higher values. The result of black migrants in Washington County being statistically significant, justified the interaction process, and confirms the movement of African Americans to suburbs or other nearby cities away from the Interstate 94 transportation line.

The spatial distribution of children (0-17 years old) in terms of clusters and outliers for Figure 4.13 seemingly appear in rural oriented areas. There are two clusters, one appearing in the high crop region and also a southern county in rural South Dakota. These two clusters could be a good indicator of future population swings as the area in South Dakota may have growing communities, while the area in Iowa may notice a depopulation event. In addition, there are three outliers spread across the rural regions estimated with low values that are surrounded by higher values. Low outliers suggest that certain areas contain high values of children in certain rural areas, which should present some optimism for many rural counties.

College age (18 – 24 years old) migration distribution is dispersed at 95% significance across the Upper-Midwest accordingly to the Global Moran’s I index (see Table 4.9). This can also be visibly seen in Figure 4.14 by processing the Anselin Local Moran’s I for college age migrants. The intensity of college age migrations in the rural and Bakken oil region did not come as a surprise as the migration of college aged movers in rural areas are very active. Griggs County and Steele County in the rural region and Hettinger County in the Bakken oil region hold low values that are clustered.

The dark red color scheme expresses counties that all have low values of in-migrants along with its neighbors. In addition, Burke County and McKenzie County in the Bakken oil region and Edmunds County and Tripp County in the rural region have values that are low but are an outlier to the nearby counties. The three counties (i.e. Cass County, Barnes County and Dunn County) in light blue have high values are outliers to surrounding counties with lower values; all located in the state of North Dakota. A multitude of statistically significant counties are found in the Bakken oil region and rural region, giving the impression these counties have the least amount of stability when it comes to college age migrants. Cass County the furthest east high-low value is where North Dakota State University is located, confirming the high in-migration value, which is surround by rural counties with less in-migrating college aged movers.

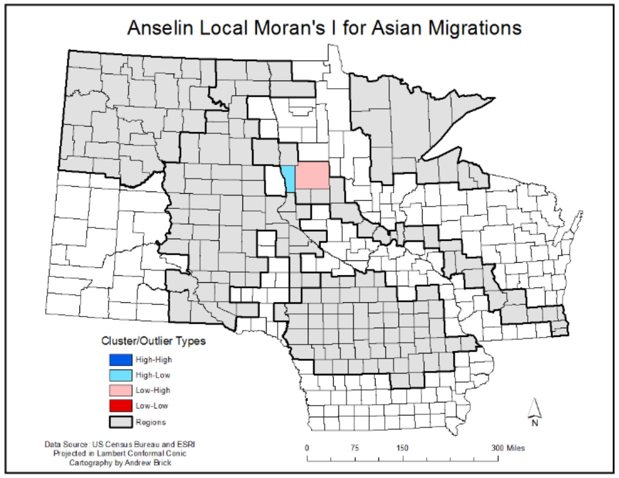

Figure 4.11 Spatial Distribution of Asian Migrants

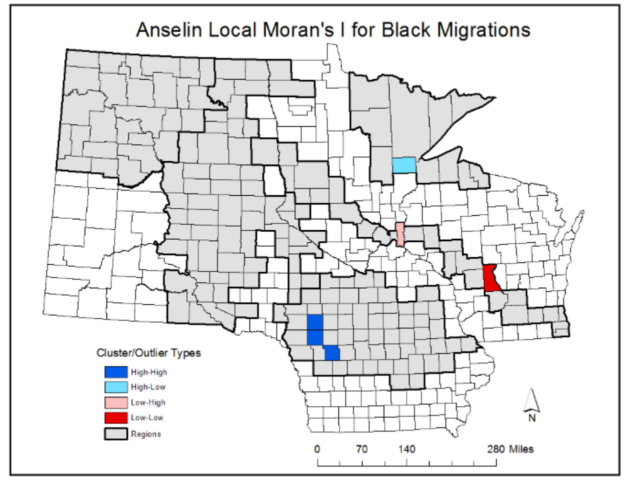

Figure 4.12 Spatial Distribution of Black Migrants

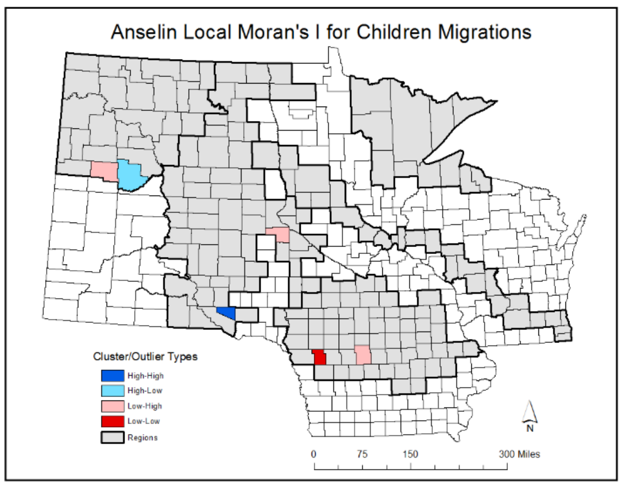

Figure 4.13 Spatial Distribution of Children Migrants

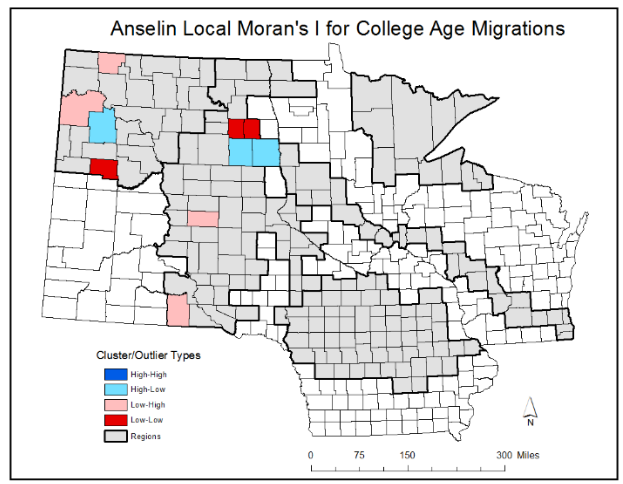

Figure 4.14 Spatial Distribution of College Age Migrants

The distribution of females across the Upper-Midwest in Figure 4.15 seems to be volatile again in the three predominately rural regions. This statement is most vivid in the rural region itself, where a group of three counties (i.e., Aurora County, Douglas County, and Hutchinson County) shown in dark blue have high valued clusters. It is the same area of South Dakota's rural region, where a high-high value of children was forming. This result and correlation of females and children suggest that families with a single parent mom were moving back home to a profoundly rural area of South Dakota, which is more family oriented than its neighbors. On the flip side two counties in the Bakken oil region, Burke County and McKenzie County, have low valued clusters and low valued neighbors, alluding to the desire to relocate to a location with social liveliness or increased employment options. All together there are six outliers, split between the two outlier types in the three rural regions. Three high-low outliers spread out across the Upper-Midwest, one being Dunn County where a major bulk of oil drilling occurred, the second in Interstate 94's Cass County that brings in females for a wide variety of opportunities (e.g., jobs, education, family, social means) and lastly Black Hawk County, which is home to the University of Northern Iowa. The other three counties, almost entirely rural, were outliers characterized as having low values with high valued neighbors in agricultural driven areas, where females are not as involved.

One of the few Local Moran's I results that appeared to be random throughout the chosen Upper-Midwest regions is that of Hispanic migrants. Only three counties (i.e., Brown County, Edmunds County, and Ida County) in Figure 4.16 registered to be significantly different, all three of them were outliers. Two of the outliers are situated in the center of the rural region; the low value outlier is the more populated Brown County, while the high value outlier is a less populated Edmunds County. The notion that a sizeable group of Hispanics moved from Brown County to Edmunds County is fairly plausible, taking into account the area of statistical significance is mainly rural. In general, the assessment of Hispanic migrants transpiring as statistically random throughout the five regions was an unexpected outcome.

A trend starting to be more evident is the vast majority of statistically significant counties emerging from rural locations in the Bakken oil region, rural region and high crop region over the more urbanized Interstate 94 and Taconite iron region. This statement is supported when viewing the mobility of male migrants in Figure 4.17. Three counties (i.e., Walworth County, Edmunds County, and Sully County) located in the rural region of South Dakota contain high valued clusters. These counties are undoubtedly rural and did not have a jump in net-migrants implying these high-high clusters are resulting from its own region. Furthermore, Hettinger County in the Bakken oil region appeared for a third time with a low-low valued cluster. An additional four counties (Benson County, Chippewa County, Hamilton County, and Webster County) with a low valued outlier are presented in the spatial distribution of males. Webster County in Iowa has been regularly surfacing as an outlier in the high crop region. Additional research at the time showed a migration event occurred in Webster County caused by a manufacturing company's decision to downsize, creating massive layoffs to people residing in Webster County and Fort Dodge, Iowa.

Middle age adults demonstrated to be the most random pattern only appearing to have one outlier in the central area of the Upper-Midwest. In Figure 4.18, only Traverse County in the rural region had a low value outlier that is surrounded by other high values of middle age adults. The middle adult age group of people between 45 years of age to 59 years of age was expected to yield more statistically different counties across the Upper-Midwest.

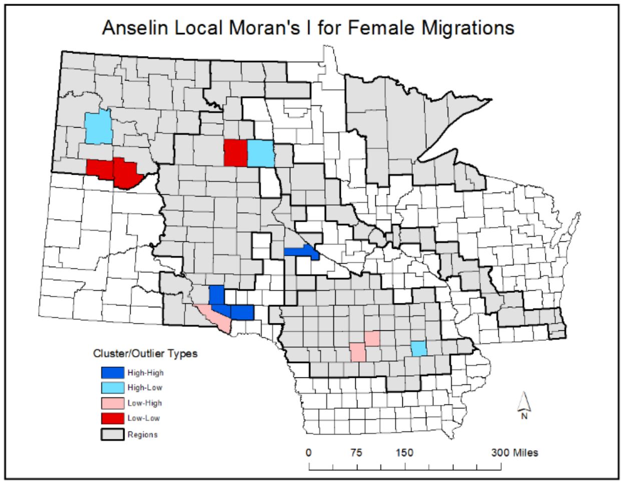

Figure 4.15 Spatial Distribution of Female Migrants

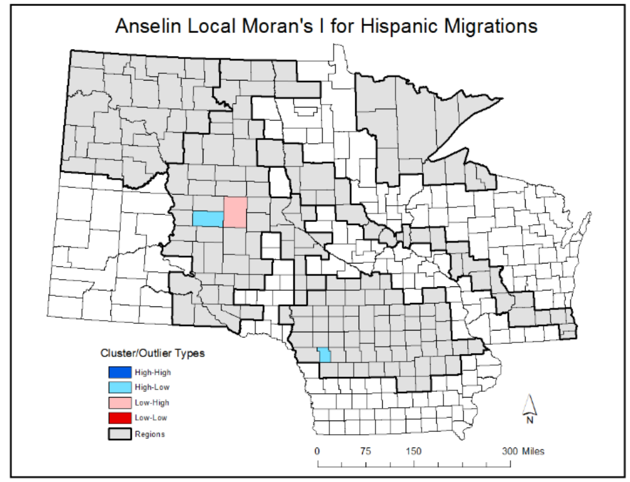

Figure 4.16 Spatial Distribution of Hispanic Migrants

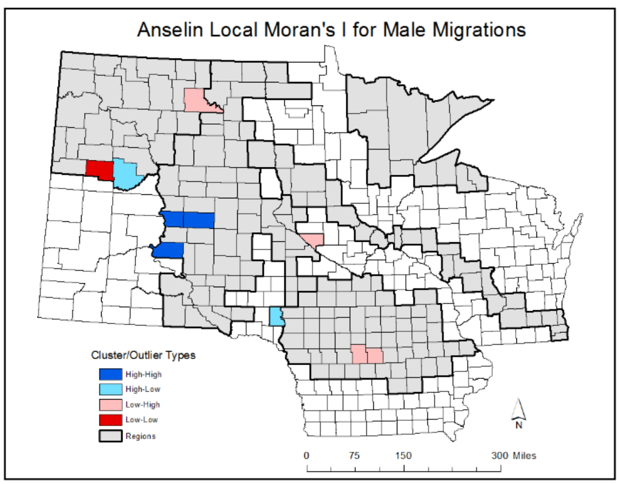

Figure 4.17 Spatial Distribution of Male Migrants

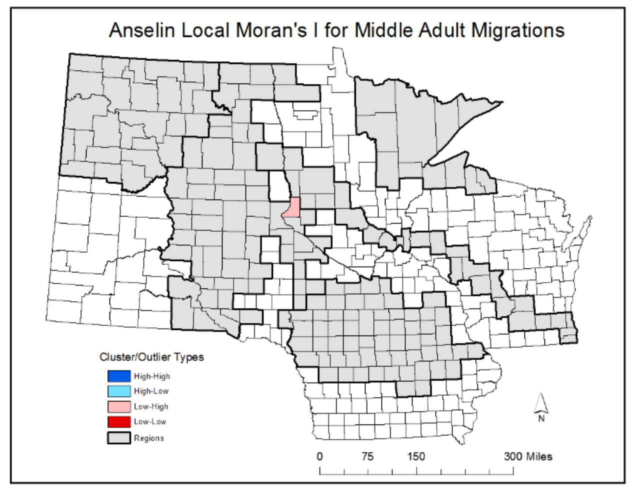

Figure 4.18 Spatial Distribution of Middle Adult Migrants

Non-Hispanic migrants in Figure 4.19 are statistically different, especially in the rural region, where two clusters of high values turned up in a southern section of the region. This is becoming a common theme with Douglas County, South Dakota that exhibits higher values than its neighbors by different demographic characteristics more times than once. It is suspected rural migrants are moving towards other rural counties since total net-migration levels were decreasing in Douglas County. This flow of rural-to-rural migrants in certain areas, such as southern South Dakota, had favorable structures in place (production of chicken factories, encouraging education systems). Moreover, Hettinger County popped up again as a low-low county, making it the fourth demographic characteristics showing a low valued cluster. Hettinger County is located away from oil drilling areas in southwestern North Dakota, where populations are very wide-spread. Along with Cass County in the Interstate 94 region, two counties in the rural region close to each other, Dickey County and Walworth County, also recorded high values with lower valued neighbors.

Other ethnic migrants seemed to have one of the more interesting outputs of the Anselin Local Moran's I index for Figure 4.20. Three counties (i.e., Ida County, Harrison County and Woodbury County) in the southeast section of the high crop region had low valued clusters. On the flip side, two high valued clusters appeared in the rural region within the familiar Walworth and Edmunds County. Over the course of testing ten different demographics with Local Moran's I, it shows five counties (e.g. Edmunds County, Cass County, Hettinger County, Douglas County (SD), and Webster County) are often being repeated as statistically significant counties all-around.

One new observable outlier showed up in the Taconite iron range with a formidable county name of Iron County. Iron County has a high value of other ethnic migrants compared to the neighboring low values. The rumor of opening iron mines during this migration analysis is perceived to be not related to this outlier since groups such as young adults and whites did not have a notable increase in migrants.

Four outliers of high valued counties surrounded by lower values transpired in the rural region for Senior Adults migrants in Figure 4.21. The four counties include Eddy County, Logan County, Ramsey County (ND), and Walworth County, which are all overwhelming rural counties. The in-migration of Senior Adults to these types of rural counties could be explained as their favored retirement destination. Senior Adults have the least amounts of migrations recorded overall and typically do not move more on the spectrum from rural to urban areas more so than urban to rural areas. Some commonly known reasons Senior Adults choose to remain in rural areas is an attachment to homes, family, friends, and community. The two low valued counties, Pierce County located nearby to the outliers in the Bakken oil region, an outlier and the other being a cluster. These counties, Pierce County and Benson County, are on the fringe of the Bakken oil region that may not be susceptible to any economic ties to the Bakken oil region even though the vast majority of statistically significant outliers and cluster in this region have been low valued.

Perhaps the most spatially significant map is that of the total populations shown in Figure 4.22. Again, all the statistically significant counties are located within the Bakken oil region, high crop region but again, primarily located in the rural region. There are five high valued clusters in southern section of South Dakota's rural region, where the most significance overall has been taking place. While investigating Douglas County's recent economic history, the county maintained low unemployment rates and had the slightest decreases in population over time. In addition, there are two counties, Chippewa County and McIntosh County with low valued clusters in the same rural region but are spread apart. A total of five counties (i.e., Dickey County, Grant County, Pierce County, Renville County, and Walworth County) with high valued outliers occur between the Bakken oil region and rural region. High valued outliers seem to be coming from rural counties with medium size towns, which other rural counties do not offer. The low values are possibly the surrounding counties filtering into the high valued outlier shown in the majority of these maps. There are four low valued outliers spread across three regions. Aurora County and Charles Mix County are two of the low valued outliers that neighbor each other and also neighbor four of the highly clustered counties. A speculation as to why low valued rural outliers flowed into the highly valued rural clusters is because of close proximity movements being an affordable transition. The years between 2006-2010 were a difficult economical time period to many citizens across not only the Upper-Midwest but the entire United States. This recent economic depression denotes that residential mobility likely occurred over shorter distances than longer, expensive movements.

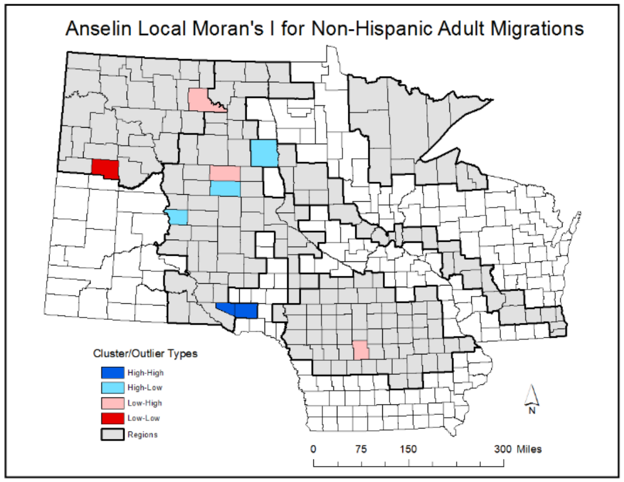

Figure 4.19 Spatial Distribution of Non-Hispanic Migrants

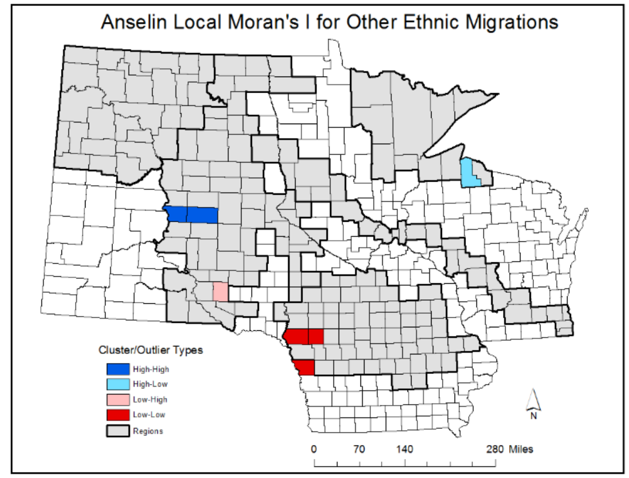

Figure 4.20 Spatial Distribution of Other Ethnic Migrants

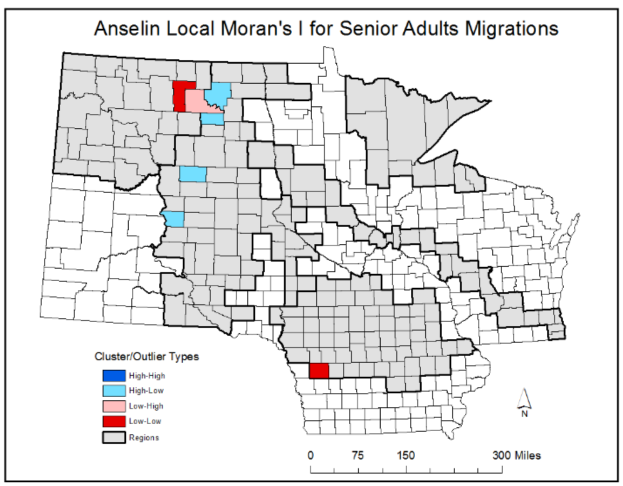

Figure 4.21 Spatial Distribution of Senior Adult Migrants

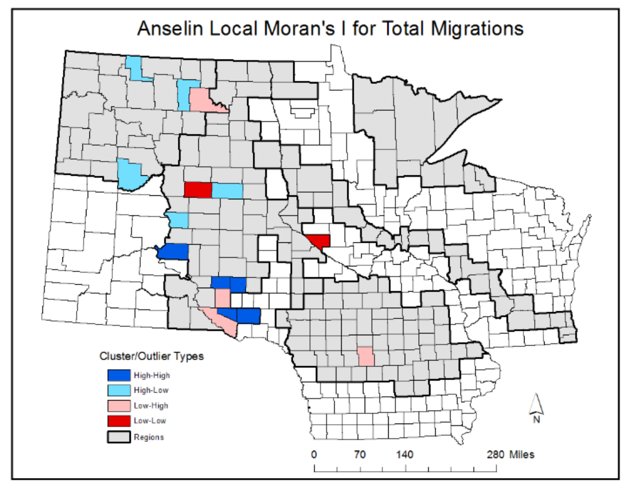

Figure 4.22 Spatial Distribution of Total Migrants

When observing Local Moran's I Index for white migrants in Figure 4.23, the output yielded very similar outcomes to prior spatial autocorrelations. Webster County was again a low valued outlier, Cass County was again a high valued outlier and finally, Douglas County (SD) rendered a high valued cluster. The only different county with a different outcome statistically was one high valued cluster along the Interstate 94 region in Wisconsin. Dunn County, Wisconsin resulted as a highly valued cluster with neighboring counties having high value of white migrants.

The last demographic, young adult migrants had a unique output. Anselin Local Moran's I Index generated and displayed a very different complexion of clusters and outliers than previous demographics. Global Moran's I rendered the demographic young adult group statistically significant by 99% in the Upper-Midwest region (see Table 4.9). Figure 4.24 seems to confirm that result with its distinct distribution of statistically significant counties. A total of eight counties in the rural region have high valued clusters with the majority of the counties coming into close proximity of each other south central South Dakota. The Bakken oil region has two low valued clusters in Hettinger County and Grant County, which were low valued clusters throughout most of the demographic migration trends. Lastly, there are two outlier counties, one a high valued outlier (Dunn County) and the other low valued outlier (Mercer County), where most of the oil drilling takes place in the region. The movement of young adults into Dunn County from Mercer County is a strong possibility.

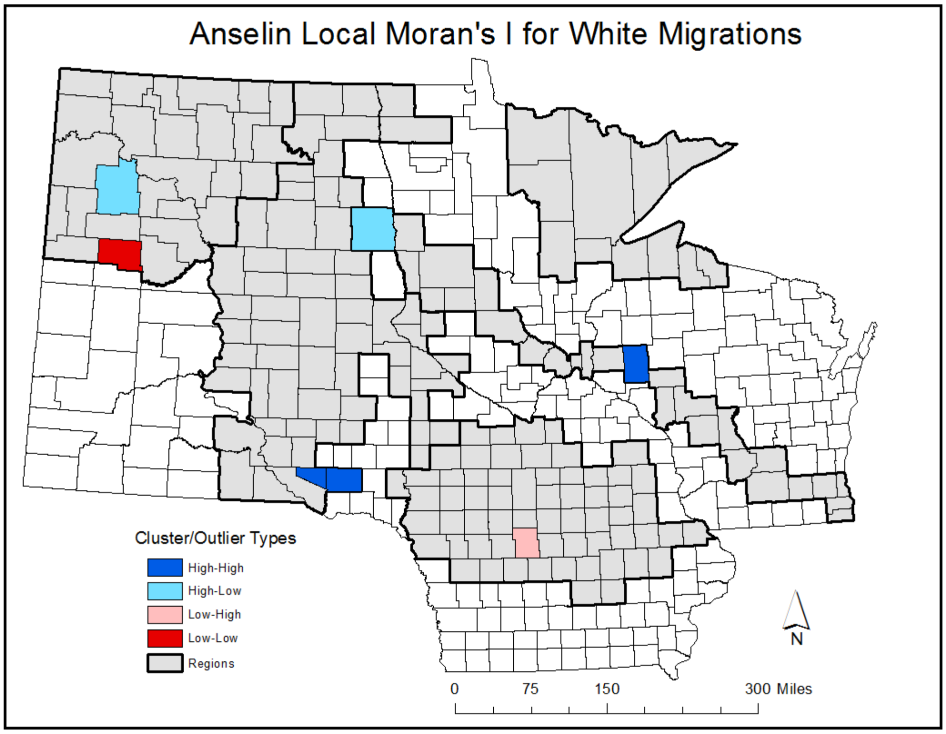

Figure 4.23 Spatial Distribution of White Migrants in Upper-Midwest Regions

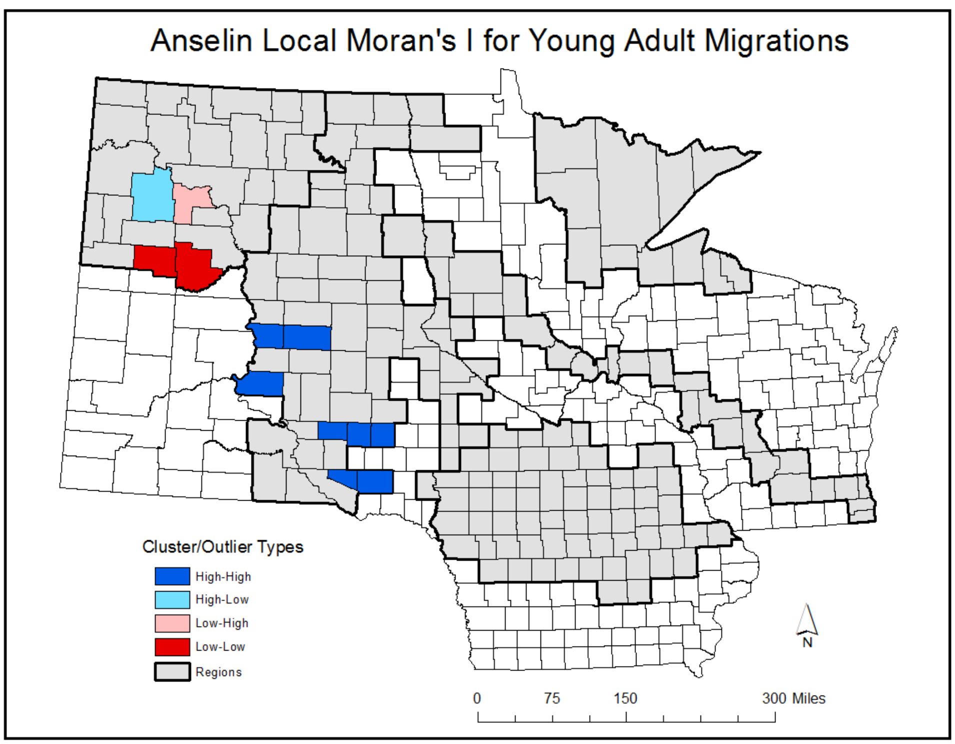

Figure 4.24 Spatial Distribution of Young Adult Migrants in Upper-Midwest Regions

CHAPTER 5: CONCLUSIONS

Human migration is the spatio-temporal course of people moving dynamically from previous settlements to new areas of residence. Scholars have already researched and provided substantial findings to human migration patterns by testing innovative spatial analysis methods and conceiving astute reasoning to why certain migrations occur. Upon gathering research and implementing a spatial analysis method on some of the recent history of Upper-Midwest migration, the material is still clearly relevant in present day. First, configuring the overall study area into separate regions for a more localized, direct perspective for critical analysis led to beneficial insights on different areas. Following data acquisition from the U.S. Census Bureau's Migration/Mobility webpage, equating CNMR as the primary variable over absolute net-estimates, produced authentic values of regional demographic mobility. Lastly, the Moran's I Index configuring CNMR provided a beneficial approach to determining areas of statistical significance, by demographic groups in a region.

This research has answered all the following research questions that the analysis set out to achieve. Through in-migration and out-migration maps on a county-by-county level, it is apparent demographic trends differ especially towards age-groupings. Many college-age migrants are moving away from rural counties towards cities with larger universities. Working-age migrants can also be seen migrating towards areas that are economically favorable, no matter if the area is rural (Bakken oil, Taconite iron) or urban

(Interstate 94). Ethnic movements are also easily distinguishable between rural and urban areas. Asian migrants seem to move to nearby cities along highway systems. On the other, hand African Americans seem to move in close vicinity to the past residence but slightly away from urban districts. Hispanics and whites are sporadic throughout the Upper-Midwest region with the Caucasian base having far greater totals. Hispanics/Latinos may be starting a new trend having moved towards nearby towns with a larger conglomerate of Hispanics/Latinos than the rural counties where agricultural jobs are plentiful. The ability to see spatially significant clusters and dispersion was successfully completed with the Global and Local Moran's I index. The Global Moran's I Index rendered the children and college age group over 95% significance and resulted with dispersed distribution. In contrast, young adults and senior adults also equated a significance of over 95% but detected areas of clustering for Global Moran's I. A second process of identifying single features of statistical significance on a county level called Anselin Local Moran's I produced detailed patterns of demographic migrations for the Upper-Midwest regions. A profound amount of counties with statistically different clusters and outliers occurred commonly over the Bakken oil region, rural region and high crop region. Interstate 94 and the Taconite iron regions only registered a few outliers compared to a high amount of clustering that transpired in the region with developing areas of rural depopulation. This all-inclusive analysis of Upper-Midwest migrations can be further advanced in a variety of directions but on its own, managed to be an importance piece to the fields of regional studies and population geography.

This research has room for improvement. First, this migration analysis in the Upper-Midwest is simply an expansive analysis for a massive land area, prompting possibilities of future analysis. Large-scale land areas (e.g., the entire United States) have been performed exhaustively, resulting to the Upper-Midwest being an original study area. The study area can thus be changed to a different region of greater interest or narrowed down to a more defined region or spatial unit. Land areas should be analyzed not only by defining basic administrative boundaries, but by designing land areas creatively, for a more accurate representation of a region. Second, other characteristics besides demographic migration flows can be further supplemented (e.g. household, journey-to-work, education, etc.), leading opportunities of correlating characteristics through regression methods, while still using a spatial platform. Statistical correlations of human components in conjunction with a spatial element is ideal for migration analyses (Leonard, 1944). Moreover, a different method that can be utilized is that of relative distance away from certain regions. For example, a future pursuit of the distances in net-migrations for the Interstate 94 region can yield advanced migration systems. Finally, any availability in past temporal flow data or demographic migration data is needed to define migration patterns occurring over time. This spatio-temporal analysis will give much realistic picture of migration patterns.

The Upper-Midwest migration analysis did not go without concerns, especially pertaining to data limitations. Excluded counts and Margin of Error (MOE) both restricted data to around half of its estimations. Also, disaggregating flows into a Minor Civil Divisions was impractical due to the states of North Dakota, South Dakota and Iowa not listing Minor Civil Division' unit codes. Advancing in time, this migration analysis can lead to many different directions and specific results. First, new demographic data will soon be released and a temporal analysis of time-series data can be cemented. Supplementary data (e.g., education status, income levels, and housing characteristics) can be correlated to existing demographic data for increased spatial analysis and migration patterns. In addition, methods such as spatial interaction, linear regression and geographical weighted regression (GWR) can be applied to fully inspect future migrations. Also, this analysis can be compared and contrasted to different areas of the United States (e.g., New England, Ohio Valley, Sunbelt or Pacific), and have geographical bound regions (e.g., transportation highway, farming sectors, river stretch) to be examined too.

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APPENDIX

Appendix A: County List by Region

Bakken Oil	High Crop		Interstate 94	Rural		Taconite Iron
North Dakota	Iowa		Minnesota	Minnesota	South Dakota	Minnesota
Benson	Benton	Marshall	Clay	Big Stone	Aurora	Aitkin
Billings	Black Hawk	Mitchell	Douglas	Chippewa	Beadle	Carlton
Bottineau	Boone	O'Brien	Grant	Kittson	Brown	Cook
Burke	Bremer	Osceola	Hennepin	Lac Qui Parle	Brule	Itasca
Burleigh	Buchanan	Palo Alto	Otter Tail	Lincoln	Buffalo	Koochiching
Divide	Buena Vista	Plymouth	Ramsey	Marshall	Campbell	Lake
Dunn	Butler	Pocahontas	Sterns	Murray	Charles Mix	St. Louis
Golden Valley	Calhoun	Poweshiek	Todd	Pipestone	Clark	
Grant	Carroll	Sac	Washington	Rock	Day	Wisconsin
Hettinger	Cerro Gordo	Sioux	Wilkin	Stevens	Deuel	Ashland
McHenry	Cherokee	Story	Wright	Traverse	Douglas	Bayfield
McKenzie	Chickasaw	Tama		Yellow Medicine	Edmunds	Douglas
McLean	Clay	Webster	North Dakota		Faulk	Iron
Mercer	Crawford	Winnebago	Cass	North Dakota	Grant	
Morton	Delaware	Winneshiek		Barnes	Gregory	
Mountrail	Dickinson	Woodbury	Wisconsin	Cavalier	Hand	
Oliver	Dubuque	Worth	Columbia	Dickey	Hutchinson	
Pierce	Emmet	Wright	Dane	Eddy	Hyde	
Renville	Fayette		Dunn	Emmons	Jeruld	
Rolette	Floyd	Minnesota	Eue Claire	Foster	Kingsbury	
Sheridan	Franklin	Blue Earth	Jackson	Griggs	Lyman	
Slope	Greene	Cottonwood	Jefferson	Kidder	Marshall	
Stark	Grundy	Fairbuault	Juneau	LaMoure	McPherson	
Towner	Hamilton	Fillmore	Kenosha	Logan	Miner	
Ward	Hancock	Freeborn	Milwaukee	McIntoish	Potter	
Wells	Hardin	Jackson	Monroe	Nelson	Roberts	
Williams	Howard	Martin	Racine	Pembina	Sanborn	
	Humboldt	Nobles	St. Croix	Ramsey	Spink	
	Ida	Waseca	Sauk	Ransom	Sully	
	Jasper	Watonwan	Trempealeau	Sargent	Tripp	
	Kossuth		Waukesha	Steele	Walworth	
	Linn	South Dakota		Stutsman		
	Lyon	Lincoln		Walsh		

Appendix B: Upper Midwest Base Map